1859 FIFTY-EIGHTH YEAR 1917

CHEMICAL LIBRARY APR 9 1917 UNIV. OF MICH. LIBRARY

AMERICAN GAS ENGINEERING JOURNAL

FORMERLY

AMERICAN GAS LIGHT JOURNAL

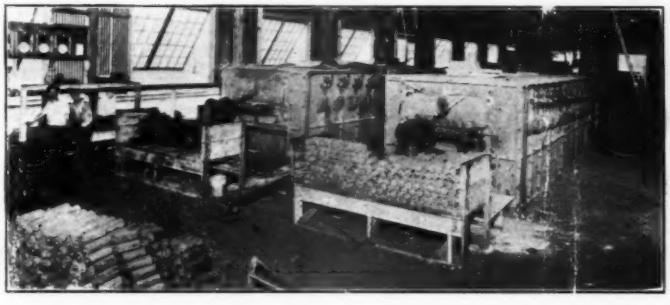
VOL. CVI., NO. 15
WHOLE No. 3083

NEW YORK, SATURDAY, APRIL 7, 1917

Subscription $3 per year
$4 Canada $5 Foreign

Specialists

in the application and installation of any and all industrial heat operations



Two Special Shell Hardening Furnaces—Capacity 5000 Shells Each, per 20-Hour Day

Consulting, engineering, design and construction work of any character relating to the application of gas for industrial purposes

THE SURFACE COMBUSTION CO.

15-21 Wilbur Ave., Long Island City, N. Y.

INDEX TO CONTENTS, PAGE 348 ADVERTISERS' INDEX, PAGE 18

TRENCHING *and* BACK FILLING

THE BIG SWIFT WAY

Cut shows Model 24, weight 7½ tons. 12", 15", 18", 24", wide, maximum depth 10'.

PARSONS

What Other Machines Have These Features?

Reverse traction and digging action.

Direct drive to digger shaft, eliminating extra friction. Case-hardened bushed roller excavator and traction drive chain. Will never wear out. Easy steering arrangement, three-point suspension.

Conveyor mounted on rollers; easy to move backward or forward to avoid obstructions.

Digger plows designed exactly like steam shovel dipper teeth.

Positive cleaning arrangement—can dig in sticky soils.

Boom very rigid and heavy—can't sag.

Machines very light and rigid, made possible by careful re-design and introduction of special alloyed metals. Extra large shaftings and gears giving strength equal to heavier machines.

All machines have very short wheel base, making them easy to handle.

Cut shows No. 10 Parsons Back Filler.

Boom of pipe construction. Can be collapsed to lengths that suit. Maximum boom length 30'.

Parsons Back Fillers

These machines can be used on any trench excavation job whether a trench excavator is practical or not.

Wherever operated they have always opened the way to other sales. Are big labor-savers.

We cheerfully answer inquiries.

THE PARSONS COMPANY

Home Office and Works
616 SIXTH STREET
NEWTON, IOWA

Eastern Sales Office
18 WEST 34th STREET
NEW YORK CITY

AMERICAN
GAS ENGINEERING JOURNAL

FORMERLY THE AMERICAN GAS LIGHT JOURNAL

Vol. CVI, No. 15 NEW YORK, APRIL 7, 1917 Whole No. 3083

Gas for Heating Galvanizing Baths Meets Coke Fuel Cost

High Rate of Work Essential to Economical Production—Three to Four Tons of Zinc Have to Be Melted to Galvanize 20 to 40 Tons of Sheets

By WILLIAM J. HARRIS, JR.
Engineering Department, Surface Combustion Company, Long Island City, N. Y.

The use of manufactured gas for heating galvanizing baths seems to have been seldom attempted in the past, and the few installations which have been tried have been unable to meet the competition of coke on a cost basis. In the installation herein described, in addition to satisfactory operation in every particular, the cost of the coke fuel was practically met, including actual saving in labor.

FIG. 1. COKE-FIRED GALVANIZING BATH

As is no doubt well known, the usual type of galvanizing bath is a rectangular steel tank of riveted or welded construction. The dimensions vary according to the character of work to be done, but may be anywhere from 2 to 4 ft. in depth by 2 to 6 ft. wide and 5 to 20 ft. long.

Because of the settling of the so-called " dross " to the bottom of the tank, it is impossible to apply heat directly to the bottom. Hence, the usual arrangement is to set the tank on a brick or sand foundation, and to build a brick setting around it with space for a coke fire between the sides of the tank and the inside of the setting. This space may be from 6 to 18 in. wide, depending on the amount of heat required, and on two or four sides of the bath, depending on whether it is long and narrow or approximately square in shape.

Process of Production

Figs. 1, 2 and 3 show a coke-fired bath at the plant where the gas installation was made. It is used for coating steel sheets of varying gauges from No. 30 to No. 18 and from 24 to 48 in. wide and from 6 ft. to 12 ft. long.

FIG. 2. NEAR VIEW OF COKE-FIRED BATH

After " pickling " to remove the scale, the sheets are run through the melted zinc by a " coating machine " consisting of a series of gear-driven steel rollers and a suitable framework immersed in the bath. In coming out of the bath the sheets are carried along an air-cooled conveyer about a hundred feet long. The operation is continuous and a high rate of work is essential to

FIG. 4. SECTION OF CASING WITH GAS BURNERS INSTALLED READY FOR BRICKWORK

FIG. 5. CASING SECTION READY TO BE SET IN PLACE

economical production. The weight of sheets coated varies from 20 to 40 tons per day of 24 hours, using from 6,000 to 8,000 lb. of zinc in the same period.

The gas-fired bath is being used for such work as has been described; the bath was originally designed for a coke fire. Instead of using a plain brick setting, however, the bath has been provided with cast-iron casings, which were lined with brick and placed about the steel tank after it had been put in position. This more durable construction was designed to make it possible to renew the tank without having to rebuild the brickwork, and it was found particularly well adapted to the installation of the standard "impact type" of Surface Combustion burners.

Fig. 4 shows a section of the casing with burners installed ready for the brickwork, and Fig. 5 shows the same bricked ready to move into place. Figs. 6 and 7 are closer views showing construction details of the corners of the setting.

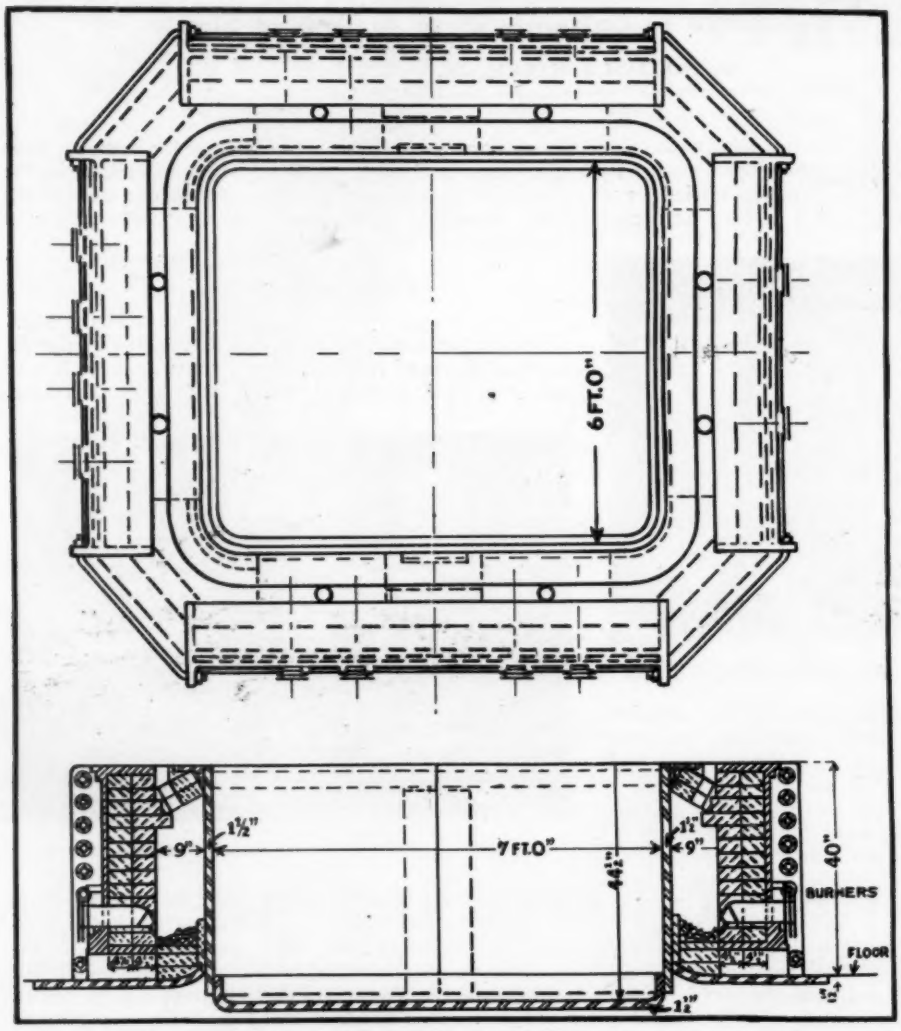


FIG. 9. PLAN AND CROSS SECTION OF GAS-FIRED GALVANIZING BATH

High Pressure Gas Used

The casing as originally made for the coke fire consisted of four straight sections for the sides and four corner pieces. The side sections being set closer to the tank for the gas installation made it necessary to abandon the corner pieces and fill in the space with brick. This is shown in Fig. 8 which is a view of the completed installation. Fig. 9 is a plan showing location of burners, refractory bed, etc.

FIG. 8. COMPLETE GAS-FIRED BATH—GAS CONTROL V. V.; INSPIRATORS I. I.; PRESSURE GAGES G. G.; HIGH PRESSURE GAS LINE H. H.

The "high pressure" gas system was used. This operates normally on a maximum gas pressure of 10 lb. per square inch and atmospheric air. In this case, however, the gas company was able to supply the gas at 4 lb. pressure. Hence the inspirators were specially designed to operate on 3 lb. at the normal working rate.

A motor-driven gas booster (Fig. 10) was installed for use should a higher rate be desired and in case the service pressure of the gas should drop. Ordinarily this is not needed, and operating costs are thereby materially reduced. The proportioning of gas and air is entirely automatic without the use of governors or any appliance with moving parts. Temperature control is obtained by the simple adjustment of the gas valve (marked "V" in Fig. 8), and as this is the only valve on the apparatus, it is absolutely a "one-valve" control.

FIG. 6. CONSTRUCTION DETAILS OF SETTING

Burners on Every Side of Setting

The burners on each side of the four sides of the setting are connected to separate inspirators which are in turn connected independently to the high pressure line. The heat on each side of the bath can thus be regulated independently or any set of burners turned off entirely if desired. A low reading spring pressure gauge (marked "G" in Fig. 8) on each inspirator indicates directly the gas pressure at which it is operating. As the proportioning of the "mixture" is automatic and uniform, this pressure gauge gives an accurate and convenient means of temperature control. Thus, if, say, 2 lb. pressure is found sufficient to maintain the required temperature at a certain rate of work, these conditions can always be duplicated or changed to meet new conditions without "guessing" at what the burners are doing.

The old coke-fire bath (Fig. 1) measures 7 ft. x 7 ft. x 44 in. deep with a capacity of 69,000 lb. of zinc, while the gas-fired is 6 ft. x 7 ft. x 44 in. deep with a capacity of 60,000 lb. of zinc. The capacity of steel coated per

day is, however, the same, and the fuel consumption was figured on this basis.

Coating 30 tons of steel sheets and melting 8,000 lb. of zinc, the coke used was found to be 4,000 lb. per day of 24 hours. The entire time of one man was needed to wheel the coke from the storage bin and fire the furnace.

At $5.50 per ton for the coke and 20 cents per hour for labor, this figures $15.80 per 24 hours.

The gas installation was sold on a guarantee that, when doing the same work (30 tons steel and 8,000 lb. of zinc), the gas consumption would not exceed 40,000 ft. of 600 B.t.u. gas per 24 hours. At the prevailing rate—averaging 41 cents per thousand—this figured $16.40.

Efficiency of Gas Fire Increases with Higher Rates of Work

On actual test immediately after the installation was completed, 28,000 lb. of steel were coated in 12 hours with 19,000 ft. of gas, or at the rate or 28 tons with 38,000 ft. per 24 hours. The temperature of the bath was maintained at about 840 deg. Fahr., and new zinc was added at the rate of 6,200 lb. per 24 hours.

It was not possible to run at the maximum rate because sheets of a heavy enough gauge to give the required weight were not obtainable. Subsequent reports indicate that the efficiency of the gas fire increases at higher rates of work and that the guarantee has been safely met.

FIG. 7. CONSTRUCTION DETAILS OF SETTING FROM ANOTHER ANGLE

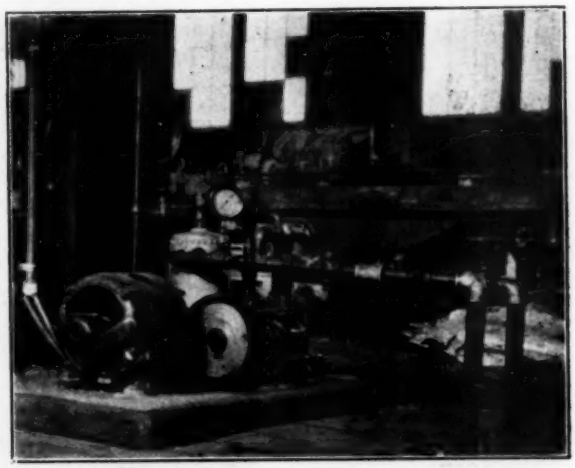


FIG. 10. MOTOR-DRIVEN GAS BOOSTER

When the bath is not in use, the coating machine is withdrawn and the temperature is maintained at about 810 to 820 deg. Fahr. with 650 cu. ft. of gas per hour. Under these conditions, the burners on two sides only are used, and by closing some of the vents in the brickwork, the flue gases are made to circulate around and come out on the sides where the burners are turned off.

It will be noticed that the fuel costs given above are for normal conditions. As a matter of fact, the high-grade foundry coke which is required for this work now costs $8 or $9 per ton and is practically unobtainable at that. As a result of these conditions and the very satisfactory results with gas, a second coke bath is to be changed over at the earliest possible moment.

This installation was made at the plant of the Chapman Steel Company, Indianapolis, Ind., and was designed and installed by The Surface Combustion Company, of Long Island City, N. Y.

Combination Gas and Coal Range Effective in Increasing Consumption Along Existing Mains

Ninety-five per cent. of the combination gas and coal ranges that we have sold have been replacing coal stoves, stated O. T. Knight, manager of the commercial department of the Peoples Gas Light & Coke Company of Chicago, discussing H. L. Dunavan's paper on "The Gas and Coal Range—Is It a Step Forward or Backward?" at the recent convention of the Illinois Gas Association. We have made an allowance of $5 on old coal ranges. In many cases advantage has not been taken of the allowance. They have still retained their coal range, but have come to us after the sale has been made and want the allowance, saying that the combination range met all their requirements of heat and so forth.

Each one of these cases practically represents a new consumer along the lines of our old mains, not in main extensions. That point, I think, is strong in favor of selling combination ranges.

There is absolutely no question but what the public is desirous of buying combination ranges rather than a straight gas range.

One of the big questions in our minds at present is, shouldn't we go further and put on the full combination—that is, a combination whereby coal can be used for baking purposes. Our records don't show that we are losing many sales by not having such a range, but we are at the point of seriously considering the proposition.

One of the reasons why such a range might be serviceable to us is from the standpoint of appearance, which has a great deal to do in the selling of these ranges to the class of people to whom we are selling them—that is, we sell a good percentage of them to foreigners, and these people seem to look upon that range as one of their handsomest pieces of furniture, and in appearance the ranges that we are handling possibly don't meet some of these large coal combination ranges. I believe that that would also have considerable effect on our sales—that is, they have got a very elaborate coal range which makes a big showing, but they can't purchase such an elaborate combination range, and that is one feature which appeals to me strongly from the sales standpoint of putting such a range on sale.

FIG. 3. COKE-FIRED BATH IN OPERATION SHOWING FIRE BETWEEN WALLS

Distributes Home-Made Bread to Increase Gas Consumption

To determine a practical way of bringing before the public in a forcible manner the attributes of homemade bread and to interest them in bread-baking, and at the same time increase our gas consumption, our vice-president, Mr. Clabaugh, decided to give a demonstration on bread-baking at our office on February 9-12; then to follow up by delivering a small six-ounce loaf of bread to the districts where we felt sure the people would be willing to be shown how to reduce the H. C. L., and allow our demonstrators to teach them how to make good, wholesome homemade bread economically, writes C. S. Phillips, commercial agent of the Omaha (Neb.) Gas Company, in *New Business*.

The large majority of the loaves were baked in the basement of the gas office during the day and night. We had the window made up to represent a kitchen, with a cabinet range, kitchen cabinet, table and kitchen utensils. We also had a large pile of loaves baked the night before, dough in all periods of raising, and a colored woman baking bread in the window. One of our demonstrators had charge of two colored women baking in the basement and the other one, helped by two floor salesmen, gave the loaves to the ladies who came in on the discount days. The loaves were wrapped in oil paper enclosing a recipe and were fastened with a narrow band of paper on which was printed "Compliments of Omaha Gas Company."

We follow this advertising up by delivering the loaves to different sections of the city where we feel that they will bring the best results.

We have hired a man to do the baking, and are trying to get a dough mixer. By getting out these loaves in quantities we will be able to cut the cost per loaf down considerably.

We will take one of our Ford cars, with two men dressed in our standard khaki uniforms, to distribute the bread. It is only delivered to someone answering the ring of the front door bell, as we feel that it would be only a waste to leave the package on the doorstep or porch. We will have some appropriate advertising on the car pertaining to homemade bread.

Phenol Used in Manufacture of Picric Acid Prepared Directly from Benzol

At the present time a considerable amount of the phenol used in the manufacture of picric acid is prepared directly from benzol, declare Carleton Ellis, Louis Rabinovitz, and A. A. Wells in an article in *The Chemical Engineer*. This is due to the limited supply of phenol from coal tar available on the market. The preparation of phenol from benzol is a lengthy operation involving sulphonation and a caustic soda fusion. The number of steps required and the losses in each step render the method a costly and somewhat difficult one.

Increased Cost of Money

The rates of interest borne by all municipal bonds sold in the United States in the fifteen years, 1901-1915, inclusive, are a striking illustration of the increasing cost of money over the period therein included, stated F. K. Shrader in a paper given before the Illinois Gas Association.

Practical and Economical Construction Can Be Applied to Single-Trolley, Direct Current Electric Railways Which Will in Most Cases Make Electrolysis Danger Negligible

Mitigating Methods Applied to Underground Pipes Fail to Attack the Source of the Trouble and Should Be Applied Only in Special Cases—Albert F. Ganz Describes Remedial Methods to Be Applied to Such Electric Railways

Experience shows that an increasing amount of damage by electrolysis is occurring on underground piping systems in many localities throughout the country where adequate measures have not been taken to reduce this damage, declared Albert F. Ganz, professor of electrical engineering at Stevens Institute of Technology in a paper presented before a recent meeting of the New England Waterworks Association at Boston. The principal and generally the sole sources of stray electric currents causing this damage are the single-trolley direct-current electric railways employing the running tracks in contact with earth as part of the return circuit.

Experience extending over many years in foreign countries and over ten years in this country has shown that practicable and economical methods of construction can be applied to such electric railway systems which will remove acute dangers from stray currents to underground piping systems and which will greatly reduce the electrolysis danger in all cases, and in most cases will make this danger negligible.

Mitigating methods applied to underground pipes fail to attack the source of the trouble and should be applied only in special cases, if at all, and then only after adequate methods of minimizing the production of stray currents have been applied to the railway system.

Metallic connections from underground pipes to the railway return circuit which cause these pipes to become a substantial part of this return circuit are inadequate for the protection of the pipes and are frequently dangerous. Such connections greatly increase current flow on pipes, and while they may afford local protection, they generally distribute electrolysis troubles to other localities where they are more difficult to find, and in this way frequently give a false impression of immunity.

Metallic connections from pipes to the railway return circuit should not be permitted generally and in no case unless a careful study of conditions has shown that no serious danger will be produced. Such connections should never be applied to an underground piping system as the principal means of electrolysis mitigation.

In view of the fact that the railway companies in common with the pipe owning companies are public utilities operating under public franchises and utilizing city streets, it is the duty of both of these utilities to co-operate in order that the causes and extent of any danger from stray currents can be more readily ascertained. Further, the satisfactory solution of the electrolysis problem is one which requires the co-operation of all of the interests concerned.

Electrolysis is an engineering problem and can be handled by engineering methods in such a manner that no hardship need be imposed nor should be imposed on any one.

There is no reason why the negative feeder system should not be laid out along the same engineering lines as the positive feeder system. I think that if the electric railway companies would realize this and the owners of underground properties would co-operate in a practical way, we could obtain a satisfactory and practical solution of the electrolysis problem.

Remedial Measures Applied to Electric Railways

The only way to entirely prevent electrolysis from stray railway currents is to prevent leakage of currents to earth from electric railway systems by the use of a separate and completely insulated return conductor, instead of using the running tracks as part of the return circuit.

This is accomplished with the double underground trolley system, in use on the surface lines on Manhattan Island and in the central district of Washington, D.C., and with the double overhead trolley system, in use on the surface lines in Cincinnati, Ohio, and on some of the outlying surface lines in Washington, D.C. and in Seattle, Washington.

These systems, while entirely effective in preventing electrolysis have not been generally adopted however, probably because of the added expense and of the added complication involved over the ordinary single-trolley system, which latter has come into practically universal use.

To change a single trolley to a double-trolley system would involve a more or less complete change in system. While leakage of current from single-trolley electric railways cannot be entirely prevented by any methods that can be applied to these railways, the amount of stray current produced by a single-trolley railway can by adequate measures be reduced to any desired minimum value.

The direct cause of stray currents from electric railways is voltage drop in the running tracks. It is, therefore, clear that by reducing this voltage drop the stray currents leaking from such tracks will be correspondingly reduced. Since stray currents must flow from the tracks to earth, the amount of stray current produced by a given voltage drop is also dependent upon the resistance between the tracks and earth.

The leakage of currents from the tracks can, therefore, be likewise reduced by increasing the resistance between the tracks and earth. The reduction of stray currents through earth can best be accomplished by the following means, given in the order of their importance.

(1) By increasing the number of direct-current supply stations in systems extending over large areas, so as to reduce the radius to which any one station supplies current, and also by supplying all of the railways in any locality from one supply station in this locality. The increase in the number of supply stations has been brought about in several American cities through the unification of electric light and electric railway interests, whereby the joint utilization of electric light and railway substations for the supply of the railways has been made possible.

(2) By increasing the electrical conductance of the tracks, through the use of heavy rails, through the use of low-resistance rail joint bonds and cross bonds, and

through the interconnection of the electric railway tracks of all systems, where these come close together.

(3) By removing current from the tracks by insulated return feeders, and by maintaining the negative bus-bar insulated from ground at the supply station, in all cases where the voltage drop in the tracks would otherwise be excessive.

(4) By increasing the resistance between tracks and earth as much as practicable, through draining the roadbed and, on private right-of-way, through maintaining the rails out of contact with earth.

Insulating Rails from Ground

Where a road operates on a private right-of-way, the rails can be often practically insulated from ground and the escape of current from the tracks prevented. For surface roads this can be accomplished by placing the rails on wooden ties above ground and using broken stone for ballast and keeping the rails out of contact with ground. In the case of railway lines operating on elevated structures, the rails can be fastened to wooden ties and kept out of contact with the structures. These rails, supplemented where necessary with negative feeder cables, also insulated from the structure, can then be used for the return conductor. In this way the return circuit is quite thoroughly insulated from the elevated structure and from earth and stray currents are entirely prevented.

It has been proposed to employ a 3-wire system for distributing current to an electric railway. In this system pairs of generators in the power station are connected in series, and the junction point between the two generators is connected to a neutral bus-bar. The trolley line is divided into sections, and half of the sections are connected to the positive side of the generators and the other half to the negative side. The tracks become the neutral conductor and are connected to the neutral bus-bar at the power station.

With this arrangement current flows in the tracks between the positive and negative line sections. The current flowing in the connection between tracks and the neutral bus-bar at the station is the difference between the current used on the positive and negative lines, and is therefore a relatively small current. This current also reverses more or less continually in direction, owing to the continually shifting loads, so that the polarity of the tracks with reference to underground structures at the power station also reverses more or less continually. With this arrangement the concentrated positive zone, usually present in the neighborhood of the power station, is removed, and there is in the neighborhood of the power station a low reversing potential condition.

Current flowing in the tracks between the positive and negative sections is also relatively small compared with the current returned by the tracks with the usual arrangement of 2-wire system, so that the practical effect of the 3-wire system is to very greatly reduce the track voltage drop and correspondingly reduce the total amount of corrosion from electrolysis. In addition to this the remaining corrosion from electrolysis is distributed over widely scattered areas.

The 3-wire system has been in use to some extent in Europe and experimental 3-wire installations are now in operation in two American cities.

The insulated track-feeder system, in conjunction with proper track bonding, usually affords the most feasible means for reducing track voltage drop and thereby reducing stray currents through earth in an existing electric railway. In this system, feeders insulated from earth, are connected with the negative bus-bar to selected points on the track network.

The insulated track feeder system is frequently confused with the system of paralleling the tracks with return feeders, which has been most commonly used in American electric railways. From the standpoint of reducing track-voltage drop the two systems are, however, totally different.

With copper feeders paralleling the tracks, the voltage drop in the tracks is reduced only in the proportion that the conductance of the track circuit is increased.

For example, an amount of paralleling copper equal in conductance to the tracks could at best only reduce the drop in these tracks to one-half. It is therefore evident that where the voltage drop in tracks is high, this system would require a prohibitive amount of copper to reduce the voltage drop to reasonably low values. With the insulated track feeder system, on the other hand, the voltage drop in the insulated feeders does not occur in the tracks nor in the earth, and therefore may be made as high as economy dictates.

It should be emphasized that with insulated feeders, the tracks in the immediate neighborhood of the power supply station should be connected to the negative bus-bar only through a suitable resistance, since a direct connection at this point would practically convert the insulated feeder system into a system of feeders paralleling the tracks, because both ends would then be in contact with earth.

Results Obtained with Insulated Track Feeder System

I have recently had the opportunity of studying the results obtained with an insulated track-feeder system in a city of moderate size, in which the direct-current railway substation is located on one side of a river. On the opposite side of this river there is located the city pumping station, and in the grounds near this station there are a large number of well pipes which furnish the city water supply.

When I first made tests in this city, a great deal of trouble had been experienced from electrolysis, particularly of the well pipes and suction mains connected to them. The reason for this was that the negative bus-bar in the substation was connected to the tracks directly at the station, and there were no return feeders carried beyond the station, so that all of the current used by the railway system was obliged to return through the tracks and earth.

As a result of this construction a large amount of stray current reached the water-piping system throughout the city, flowed toward the railway substation and then left the water pipes to return to the railway return circuit. As a matter of fact the water pipes entering the pumping station grounds carried a total average current of from 50 to 100 amperes, which left the water piping in the pumping station grounds, and thereby caused the destruction of this piping by electrolysis.

In order to remedy these conditions the railway company repaired all defective track bonding and installed an insulated return feeder system. Insulated feeders, in some cases with resistors in series, were carried from the substation to four points in the track network located at some distance from the station, and the connection from the tracks to the negative bus-bar at the substation was made through a resistor so proportioned that the tracks in the neighborhood of the substation would not be the point of lowest potential in the track

system. After the track feeder resistors had been finally adjusted there was not a single location at which the pipes were at all times positive in potential to the tracks, and even in the neighborhood of track feeder connection points there was a low voltage of continually reversing polarity, averaging less than one volt. At other locations the water pipes also reversed continually in polarity or were at all times negative to the tracks.

A comparison of the currents found on the water mains before the railway improvements had been made, and after these were completed, show that the reduction in these currents is very great.

For example: a current of 27 amperes was reduced to 1.3 amperes; a current of 33 amperes to 2.4 amperes; a current of 8 amperes to 0.5 ampere; a current of 8 amperes to 0.07 ampere; a current of 18 amperes to 0.6 ampere; and a current of 3.7 amperes to 0.9 ampere.

In addition to the large reduction in the amount of current on the water pipes, the remaining relatively small currents reversed more or less continually in direction, whereas the former large currents all flowed in one direction, namely towards the pumping station grounds.

The reduction in electrolysis troubles in this city is therefore very much greater than expressed by the reduction of currents on the water mains, and in fact with the continually reversing currents and potentials there should now be little if any trouble. I believe that reference to those results is the best illustration that I can give you of the effectiveness of improvements in the railway return circuit in reducing electrolysis troubles from stray currents due to single-trolley electric railways.

There are invested to-day in this country hundreds of millions of dollars in single-trolley electric railways which operate under franchises permitting them to use this method of operation. The use of the insulated track feeder system is a plan which can be adopted by such single-trolley railways for the purpose of minimizing electrolysis troubles without requiring a change in the system of operation, and at a cost which is well within practical limits. It should be stated, however, that with the insulated track feeder system the power losses are increased over what they would be if the same amount of copper were employed in parallel with the tracks. This increase in power losses is a necessary and legitimate expense incurred for the purpose of reducing stray currents through earth and correspondingly reducing injury to underground structures.

Power of Advertising

Last year the public paid for one manufacturer's chewing gum the enormous sum of $35,000,000. This purchased an amount, which, if the individual sticks were fastened end to end, would form a ribbon which could be wound around the earth at the equator five and a half times with a goodly length left over.

The manufacturer of this gum had an original capital of only $32, but he had great faith in the power of publicity and modern selling methods. He constantly and consistently spent a fair per cent. of his revenue in advertising and now has acquired a fortune of several million dollars. He is now spending annually the sum of $3,000,000 for advertising. This sum is over 8½ per cent. of the retail price of all the gum sold.

Selling the Consumer and Keeping Him Sold

In the gas business, the beginning of service is at the point where a citizen applies for gas, either by telephone or letter, stated L. C. Elliott in a paper presented at the recent Old Colony Gas Company convention.

Every salesman should make the prospect feel that it is going to be a pleasure to do business with the company. Infinite patience is required of the salesman in acquainting the prospect with the company's rules and regulations, which may be thoroughly understood by the salesman, but not by the prospect.

When the prospect signs an application for the installation of a service, meter, and appliances, they should be so thoroughly "sold" and convinced of the advantages of the investment, that they will not insist upon the work being done the next day, but will be willing to wait for their turn, or to abide by the schedule which the salesman should have to figure upon.

I have often heard it said that only the manager, superintendent, or the fitter foreman, can make promises, but it should be remembered that the salesman is practically the only person who comes directly in contact with the person applying for gas, and if he has a definite schedule to work upon, he is not likely to say the work will be done any sooner; and, if he is a *good* salesman, he can make the "other fellow" agree to it. No order should be rushed in ahead of a previous order, unless absolutely necessary, and this necessity should be decided by the manager, superintendent, or the fitter foreman.

Then, when the service is installed, the meter set, and the appliances connected, the opportunity is again presented to give good service in the maintaining of these appliances. We must "keep" our appliances sold, and our consumers satisfied.

After the installation work is completed, and an account opened, it is then up to the office and accounting department to serve the consumer.

We should try to make our consumers feel that we are rendering a personal service, not merely doing our duty.

Obtaining Trained Workers

"Over two million children and youths are being recruited to industrial and commercial enterprises every year in the United States and Canada. These raw recruits are simply thrown into new conditions and relations without any definite training for their task," declares George L. Sprague in *Industrial Canada*.

The percentage going to work at this age with definite training is but a drop in the bucket. What wonder that employers bewail the shortage of skilled workers. What wonder that the labor market is overstocked with masses of unskilled workers.

It is folly to expect that, without any definite system of training, such a mob of raw recruits can be transformed into an efficient industrial army.

The spasmodic efforts of a few employers here and there will never meet the need. The wise efforts of a few cities which establish trade schools will not suffice. The provision to meet this situation must be as large in scope as the numbers involved.

Some form of training for life should be provided for all who enter agricultural, industrial and commercial occupations.

Prosperous Public Utilities a Necessity to Growth of Other Industries

Market Price of Securities Not a Safe Basis for Rates or Earnings—Capital Raised on Bonds, When All Factors Are Taken into Consideration, Figured on Practical Basis, Cost Utilities in Reality 6.2 Per Cent

A reasonably rapid growth and development of the services rendered by public utilities, is absolutely necessary to the growth of the population, and the development of the resources of the country or for the well-being of the people, declared Halford Erickson, of Hagenah & Erickson, consulting engineers, of Chicago, in his paper at the recent annual convention of the Wisconsin Gas Association. Whether such developments will take place as rapidly as needed, depends almost entirely upon whether the rates allowed these utilities for the services they render from now on will be high enough to yield reasonable returns on the capital, and thus to induce investors to supply the additional capital that is needed.

What constitutes fair returns upon a fair valuation of the investment, while it embraces many ethical features, is primarily, a question of facts. These facts are found in the business world. They relate mostly to the amount of property and net earnings by which securities of different kinds in the different lines of enterprises, and under varying conditions as to risks involved and other circumstances, must be protected in order to sell at prices under which the yield thereon corresponds to the ordinary income on investment propositions.

Fair return in its broadest sense means fair allowances for rent of land, for wages of labor, for interest on the capital used and for profits on the services of the enterpreneur or enterpriser. That is, it means reasonable compensation for each of the factors of production. In a narrower sense fair returns are limited to reasonable amounts for interest and profits. While interest and profits thus represent the returns for two separate factors of production, the resemblances between them are close enough so that they may be discussed together.

Changing Conditions in Business World

The utility laws and the courts express the same ideas in slightly different language. The utility laws provide that for adequate service the utilities are entitled to reasonable rates. The courts usually hold that utilities, over and above other operating expenses including depreciation, are, under normal conditions, entitled to rates that will yield fair amounts, for interest and profit, on the fair value of the property, business and equities that are employed in serving the public. These laws and these rulings apply, for the most part, to public utilities including common carriers, where both the quality of the service and the rates charged for such service are subject to government regulation. In the business world outside of the utility field, the returns are regulated by the forces of free competition.

It is often said that the provisions in the laws and the holdings of the courts upon what are fair returns, are too indefinite to be of much if any practical assistance as a guide in dealing with these questions. These criticisms do not seem well taken. What are fair returns for interest and profits depend upon many conditions. They differ so much from one set of conditions to another, and from time to time, that it is, and probably always will be, impossible to definitely lay down, in a law or in a decision, just what is a fair rate of return under each of these sets of conditions.

In the business world little or nothing remains settled very long. Conditions therein are constantly changing. One development follows close upon another. What is a fair rate in one case is not so in other cases. The fairness of the return involves not only the fair value of that which is used in the service, and upon which the returns are measured, but also the fairness of the actual amount of the returns themselves.

It further involves the changes which constantly take place in the purchasing power of money; what proportion of these returns should be borne by each of the different branches of the business? What returns are necessary to secure the new capital needed to meet all just demands for additional service? What levels of rates or returns in each case are likely to promote and retard the growth of the business? What are the probable conditions upon which investors may be willing to furnish capital in the future; are the circumstances by which the plant is surrounded normal, or such that its business can be made to yield fair returns?

These and numerous other conditions make it impossible to provide in a law what should be the actual rate of return in each particular case, or in a decision what is the specific fair rate of return under any other conditions than those which are under consideration.

What Constitutes Fair Returns

In interpreting what is thus meant by the term fair returns, some hold that it is the return or cost at which the necessary capital for proper developments can be had; others say that the fair return is measured by the income basis upon which the existing securities of an enterprise, or similar securities of other enterprises, are selling in the open market. There are also many other views upon this point most of which cannot be gone into at this time. The former of these two views seems to be in line with the best interests of both the public and the investor; the latter appears unjust to both. In endeavoring to make this clear, I will analyze the latter view first.

The yield or income basis upon which securities are ordinarily selling in the open market does not, as a rule, represent a fair basis for those returns for interest and profits which must be provided for in the rates charged for the services rendered by the utilities. There are several reasons for this. The income basis computed from the rates of interest and dividends borne by the securities and from the market prices of these securities do not represent the net earnings and the amount of property required by the investor for the protection of the securities in order that they may sell in the market on the income basis in question.

Again, the market price of the securities also, as a rule, fails to take into account such expenses as the discounts at which the securities may have had to be sold, the commissions charged for marketing the securities, and the legal and other costs connected with issuing them.

It also frequently happens that the securities, for special reasons, such as the desire for control, or for family and other relations, are selling at much higher prices than would be obtained if the yield or income was the only element that entered into their price. That the actual income obtained from the securities at the prices at which they are quoted in the market do not represent a safe basis for the income or net earnings that must be provided for in the rates, or for the net earnings required by the investors, will become clear when the facts involved are more clearly explained.

Demands of Investors Must Be Considered

In the last analysis capital is furnished by the public, that is, by millions of investors, big and little, throughout the country. These investors demand such rates of interest upon the capital they furnish as will compensate them for the sacrifices they make and for the risks they assume in placing their money. They also place their funds where conditions are such as to suit them best.

They withdraw from fields where conditions are unsatisfactory from their point of view. They cannot be compelled to place their funds against their will. In the aggregate they determine, in a general way, the conditions and terms upon which the capital they supply may be had.

These terms the borrower and the seeker of capital must, as a rule, accept if he desires to obtain the funds he is seeking. Public utilities are constant borrowers, and this for the reason that they almost constantly need additional capital for additional facilities in order to meet public demands for more and better service.

Such improvements must also, as a rule, be made without delay when needed, for utilities are required by law to furnish adequate service at all times. Nor can such improvements long be postponed without serious injury to the public.

Utilities seeking new capital must obtain such capital upon terms that are about the same as those which apply to other borrowers who are similarly situated. In this respect the utilities are even worse off than other seekers of capital for, unlike strictly private enterprises, they cannot often postpone new extensions to those stages or cycles in the money market when capital can be had upon the most favorable terms.

Among the conditions upon which investors can thus be induced to furnish capital are protection against risks to both the principal and the income thereon. Bonds in order to be safe, must have behind them much more property than their face value, and much greater net earnings than the amount required for interest on the bonds. Likewise the stock in order to be reasonably safe, must also have property and equities behind it, as well as much greater net earnings than the amounts or rates regularly paid as dividends thereon. These excesses in property value and net earnings over the face value of the securities, and over the interest and dividends directly paid thereon, is a margin of safety which must exist, or be reasonably well assured, if capital is to be had upon an investment basis, or upon favorable terms to both the plants and the public.

Without such margins of safety the securities are speculative instead of investment propositions, and the cost of obtaining capital on such speculative securities, if it can be had at all, is very great as well as burdensome to all concerned.

As the amounts thus paid directly and regularly for interest and dividends plus the margins of safety must be covered by the rates charged the public for the service, it is clear that the real cost of the capital and of the enterpriser is represented not by the income basis at which the securities are selling in the market, but by the combined amounts of what is regularly and fairly paid as interest and dividends, plus such margins for safety as the investor may require.

Fair Return Is Return Upon Which Capital May Be Gotten

Many five per cent. bonds which are selling at par, and, therefore, show a yield of five per cent., did not net the issuing company more than 30 per cent. In such cases there was thus an expense connected with the issue, which amounts to 10 points or per cent. This expense was probably made up of about 6 points for discounts, of 3 points for commissions for marketing the bonds, and of about 1 per cent. for legal and other issuing expenses.

When these costs of ten points are prorated upon a twenty-year bond it is found that they amount to about half of one point or per cent. a year. When discounts, commissions, and issuing costs are thus taken into account, it is found that the annual cost, above the margins for safety, is 5.5 per cent. instead of only 5 per cent. as indicated by the market price when such securities are selling at par.

While it is thus very clear that the income yield on the prices at which the securities are quoted in the market, cannot fairly measure what is a fair rate of the net earnings for returns upon the investment, there are many who still cling to this view and who also endeavor to put their views into effect. These efforts are extremely detrimental to all concerned. They are unfair to the plants and injure their credit. They are also harmful to the public for they ultimately retard extensions of the service and tend to lower the quality of such service. It is, therefore, exceedingly important that all the elements which enter into the fair rate of earnings for returns should receive full and careful consideration, and that this most vital question be placed in its true light.

Since the income yield on the prices at which securities are quoted in the market is not a true indication of the real cost of the capital and the enterprises, or of what is a fair net earning for return for these two factors of production, we are forced to fall back upon the first in order of the two sets of views outlined above, namely the one which holds that the fair returns are represented by such returns or net earnings as those upon which the necessary capital can be had. The returns or net earnings upon which capital can be had include not only the necessary annual interest and dividend charges, but the average annual proportion of all necessary discounts, commissions, and other expenses connected with the issue, together with such margins of safety in the way of surplus earnings as the investors may require for their own protection.

Cost of Money Obtained by Utilities on 5 Per Cent Bonds

It must be admitted that, in the public utility field, the net earnings for returns for interest and profits upon a fair valuation of the utility and its business, must be high enough to cause capital to flow freely into this industry. A lower net earnings than this would surely cause capital to turn from this field into other fields.

It would prevent existing utilities from increasing their facilities so as to be able to adequately meet the increasing demand for more and better service that are constantly made by a rapidly growing population and by constantly expanding industries. It would also prevent new and much needed utilities from being established.

In short, it would deprive the public of services which to-day can be classed among the necessities of life. In addition to this, it would also tend very strongly to retard the growth of other industries, especially those which depend upon public utilities for service in some form.

Representative first mortgage bond issues covering gas, electric and street railway plants brought out the past few years bearing interest at the rate of 5 per cent. were placed on the market at prices under which they yielded the investors from 5 per cent. to more than 6 per cent. The cost to the issuing companies when discounts and other expenses are included, amounted to about 6.2 per cent. These issues did not cover more than about one-half of the book value of the property, and were protected by net earnings that averaged considerably more than twice as much as the amounts required for interest on the bonds.

During the same period representative second mortgage bonds covering similar properties bearing rates at 5 and 6 per cent. were offered at prices which would net investors about 6.5 per cent. On these bonds the discounts and selling expenses amounted to about 7 per cent. on the par value of the bonds. These additional costs when prorated on the life of the bonds brought the cost of the capital to the utilities up to even higher figures. These issues were not quite as well secured as the issues previously mentioned.

Some of the very best utility bond issues covering less than one-half of the value of the plants and protected by earnings that in most of the cases amounted to several times as much as the bond interest have sold of late on something over a 5 per cent. income basis.

A great many utility *note issues* have of late years been offered at prices which would yield investors from 6 to 6.5 per cent. In these cases the discounts and other expenses often made the cost to the utilities as much as 8 per cent. or more per annum.

Several preferred stocks protected by earnings amounting to from 18 to 40 per cent. thereon have sold at prices on which they yielded from 6 to about 8 per cent. With discounts and other expenses included the capital obtained on these issues cost the utilities at least one per cent. more than this.

A large number of utility bond issues protected on the average by not far from twice as much property and earnings as the face value of the bonds and the interest charges have sold at prices on which the yield averaged over 6 per cent. The cost to the utilities, however, when all outlays and deductions are included considerably increased this figure.

Changes Taking Place in Character of Securities

The public utilities securities which have thus been discussed belong for the most part to the large utilities which are fairly well known and for which there is a fairly well-developed market. For the smaller utilities which are less well known and for which the market is much more restricted the cost of the capital is considerably higher than the figures thus given herein.

These figures as to the average income or yield, under the conditions given, of such standard securities as those just mentioned do not always represent the actual situation. In some cases they are deviated from because of special conditions, in other cases again because of more general causes.

Changes, for instance, are taking place not only in the cost of the capital itself, but in the character and investment position of the securities. When the result of such changes can be more closely estimated in advance, it is also likely that the prices of the securities will be affected thereby. Close and extensive inquiries into the prices at which investment securities have been selling, however, indicate quite clearly that the deviations from the facts as given are fewer than might be expected.

From 5 to 5½ per cent. thus appears to be the yield obtained on the market prices at which such bonds or securities are selling, which are amply protected by property and earnings against risks. Bonds which do not amount to much more than from one-half to two-thirds of the property and equities they cover, and for which the 5 to 5½ per cent. interest charges thereon do not amount to much, if any, more than one-half as much as the net earnings of the plant, come in this class. When, as in the case of stocks and other securities in this class, the investors receive a greater return than from 5 to 5½ per cent. then the excess should be regarded as compensation for the risks involved. Standard stocks which are selling on bases on which they yield about 6 to about 6½ per cent. are usually protected by property and equities over the par value of the bonds that amount to about as much as the par value of the stocks, and by net earnings above the interest charges on the bonds that amount to from one and one-half times to twice as much as the amount required for dividends. A stock in this class on which about six per cent. is paid in dividends must, therefore, have net earnings available for that purpose of not less than nine per cent.

Concrete Example

In order to illustrate a little more fully just how these principles and facts work out in actual practice, they will be applied to a plant worth in all say $100,000, about 60 per cent. of which is represented by bonds, and 40 per cent. by stocks. The bonds bear interest at 5½ per cent.; while the regular dividends on the stock amount to 6½ per cent. The net earnings of the company upon the entire value of its property and equities foot up to 7½ per cent.

In this case, $3,300 would be required for interest on the bonds, and $2,600 for the regular dividends on the stock. These two charges would, therefore, foot up to $5,900; and would leave about $1,600 as a margin of safety for stockholders, and for such extra compensation as the stockholders require because of extra risks, responsibilities, and work which they must assume.

In this case further the bonds would be protected by 40 per cent. to 50 per cent. more property than their par value, while the interest charges thereon do not amount to much more than 40 per cent. of the net earnings. A road or a company which is in such position as this can be placed in the investment class. It can easily secure all the capital it needs for such new facilities and extensions as are in line with sound business judgment. This, however, would not have been the case had the

(*Continued on page* 353)

AMERICAN
GAS ENGINEERING JOURNAL

FIFTY-EIGHTH YEAR

Published Weekly by
AMERICAN GAS LIGHT JOURNAL, INC.
42 Pine Street, New York, N. Y.

ELBERT P. CALLENDER, President
STANTON G. KRAKE, Vice-President
FREDERICK A. SOUTHWORTH, Secy.-Treas.

EUGENE C. MILES, Editor

WESTERN MANAGER
E. B. FRITZ

CHICAGO OFFICE
537 So. Dearborn St.

Subscription $3.00 per year, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines.
In Canada, $4.00. Foreign, $5.00

Entered at the Post Office, New York City, as Second Class Matter.

CONTENTS

GAS FOR HEATING GALVANIZING BATHS MEETS COKE FUEL COST, BY WILLIAM J. HARRIS, JR. 337

PRACTICAL AND ECONOMICAL CONSTRUCTION CAN BE APPLIED TO SINGLE-TROLLEY, DIRECT CURRENT ELECTRIC RAILWAYS WHICH WILL IN MOST CASES MAKE ELECTROLYSIS DANGER NEGLIGIBLE 342

PROSPEROUS PUBLIC UTILITIES A NECESSITY TO GROWTH OF OTHER INDUSTRIES..... 345

EDITORIALS 348

LABOR PROBLEM THE GREATEST DIFFICULTY IN ENGLISH GAS WORKS IN WAR TIME, BY NORTON H. HUMPHRYS..... 351

NEWS OF THE GAS INDUSTRY..... 357

SOCIETIES AND ASSOCIATIONS..... 360

CONSTRUCTION NOTES WILL BE FOUND ON PAGE 16 OF THE ADVERTISING SECTION

The Place of the American Gas Industry with the Nation at War

Modern warfare requires the use of an immense quantity of high explosive shells. These shells depend for fillers upon picric acid and trinitrotoluol, by-products of the distillation of coal. The President in his message to Congress points out that in providing for our own needs we must not do so to the deprivation of those of the countries we are now aligned with in a common cause. This means, in short, that, in addition to the vast quantities of the derivatives the American coal-distilling interests have been producing in the past few years, a tremendous increase must be added.

It does not seem an exaggeration to state that the gas industry is the nation's most important industry in the present crisis. It faces a responsibility and an opportunity that is beyond the power of the imagination to picture. Increasing our output and finding a market for the increase becomes more than merely good business. It is a patriotic duty.

In the bulk we are fortunate in that we are prepared to assume the new responsibility and to discharge it adequately. But the gas industry must become an efficient industry to an extent it has never before attained. It is not sufficient that our large plants alone should be models of efficiency. The movement should extend to the smallest unit existent.

We are in for a thorough overhauling. There are plants and practices that are due for the junk heap. Insofar as we make haste in consigning them there, to that extent will we be able to discharge our full obligations to the nation.

There are many reasons why some of our plants are not entirely what they should be. Some of them, due to the short-sightedness of rate-fixing bodies, have been barely ekeing out an existence. New capital is necessary to new equipment. And new capital is not obtainable unless the demands of investors can be met.

There has been prevalent what has seemed to this journal a foolish pride on the part of the industry in general on the matter of applying for increases in rates. Many companies have been, and are, in visible distress because the prices they are compelled to pay for raw materials are so abnormally high, yet the selling price of the finished product remains at the same level. Instead of following the obvious course we have been pointing with fatuous pride to the fact that while everything else has gone up the price of gas has remained at the same level that it was, and, in particular cases, has gone lower.

This is not good business. Keeping up operations under such circumstances are possible; the facts have proved this. But in this practical world we seldom get something for nothing. Some sacrifices must have been made to accomplish these results. Possibly many necessary improvements have been held up to accomplish what we have.

This attitude towards rate increases is a foible which we may indulge ourselves in under ordinary circumstances. But in the present emergency all such vanities must go by the board.

Our duty now is to the Nation. If our plants are not ready to discharge this duty to the best advantage we must make them so. New capital is necessary to accomplish this. An attractive rate of return is necessary to obtain this capital. If higher rates are necessary to give that return, then we should immediately seek the increase.

The Country's Great Industrial Reserve

Elsewhere in these columns we publish an article by Norton H. Humphrys, which deals in part with the results being obtained in England in the employment of women in industrial work.

Several authorities have pointed out that this country's great industrial reserve is its women. It is certain that there exists in this country a great labor shortage at the present time. It is doubtful if the termination of the war will bring us any appreciable relief. Europe is quite likely to have ample need of its own men.

In a large part we are solving the problem by the installation of labor-saving equipment. The work of the machine is being substituted at a constantly accelerating degree for that of man. With the return of our industries to normal activities this tendency will be greatly extended. Many companies right now would be glad to utilize the assistance of the machine, but the machine is not to be had, or, if so, at such a price as to make it seem prohibitive to the eyes of some of those who have not awakened to the fact that we are living in abnormal times.

But sooner or later we must look to our industrial reserves. Our country has become to a much greater degree than ever before a world's industrial factor. We are going into the foreign trade. We will sell to a wider market than ever before, and, consequently, must produce more.

Gas company executives, and those who aspire to such posts, would do well to study the experience of England in the employment of women for industrial work. The day may be far distant when they will have use for the information thus obtained; then, again, it may not. But when it comes, the man who has thus prepared himself will not waste large sums of his company's money in blind experimentation. He will be able to profit by the experience of others.

Saving Labor by Using Gas Fuel

William J. Harris, Jr., in his article on gas applied to heating galvanizing baths, which is published elsewhere in this issue, presents to us a very striking instance of the labor-saving advantages of using gas fuel. Here we have a particular man assigned to a particular task.

"It takes all of the time of the one man to supply coke to one bath," states Mr. Harris. This does not leave very much doubt as to what the man was doing, what he was paid for, and to what account the expense of hiring him, keeping his time and paying him should be charged.

Even as Mr. Harris presents it, it is a strong argument in favor of gas fuel. But the author has apparently written his article with a view to providing a future reference rather than to present-day conditions. He figures the man at the rate of 20 cents per hour and coke at $5.50 per ton. These are the rates—or have been—of normal times. The present is an abnormal time and the prevailing costs in each case in proportion.

This journal wonders if our industrial men are playing up existing conditions to their full advantage in securing fuel business. The labor problem is not confined to the gas industry alone. It is generally acute throughout all the industries, and it daily becomes more so.

Assuming that this galvanizing manufacturer is willing to pay twice the sum Mr. Harris sets for this wheelbarrow operator's services, does that solve the problem? It assuredly does not. The "hard to get help at any price" phrase is more than a theory. It is an actual fact.

It is doubtful indeed if many industrial gas installations could not be secured on this basis alone, even if the manufacturer had to pay a premium on fuel costs greater than the ordinary compensating advantages of gas can offset.

"But these customers will be temporary," it may be argued. "They represent no real progress."

This journal believes one of the great problems in the industrial fuel gas field is that of education. We can talk the advantages of gas to the very skies, but our importunities will be unavailing until the prospect is able to visualize them. These so-called temporary installations would be dumb missionaries of our cause; things to cite as examples and constant opportunities for study in our efforts towards perfection in industrial fuel gas equipment.

The Relation of the Gas Industry to the Military Needs of the Nation

The action of the Pennsylvania Gas Association in securing as a speaker at its forthcoming convention Captain James H. Burns on the relation of the gas industry to the military needs of the nation, is an especially timely and valuable service, and is to be commended. Few gas men who read and think are ignorant of the important part the gas industry in European countries has had in the present war, and few have failed to prepare the industry in this country insofar as was possible to render as efficient aid as possible to our government in case of eventualities.

But the vast majority of the public is totally ignorant of this relationship. It is but part of wisdom to clear away this cloud and disseminate such knowledge broadcast so that we may have the cooperation necessary to enable us to avoid every possibility of failing, even in the least iota, in discharging our great responsibilities in case of an eventual sudden call.

It is unfortunate that this situation has caught many of us, through no fault of our own, manufacturing

gas to a candle-power standard. The failure of the various regulatory commissions to order the adoption of the heat unit standard has provided the weak link in our armor.

The call for greater quantities of the by-products necessary for the National needs calls necessarily for a greater production of gas. For our market for this increased output we must look to the heating business —both domestic and industrial. Had we been manufacturing to a heat unit standard we would already have on our lines a vast amount of this business. The foundation would have been laid. Building upon it would be a comparatively simple task.

Our lighting consumption must of necessity, at least temporarily, fall off greatly. Stripped of the constituents necessary for the National needs the name illuminating gas will be a misnomer. Its use in the open-flame burner, of which there are a vast number still in use, will be practically impossible. This will force a general adoption of the incandescent mantle, to the great economy of the consumer and eventual good of the gas industry. The effect of this on volume sales of gas for lighting will be enormous. By strong campaigning we may secure a sufficient increase in new customers to offset the loss, but no considerable strides will be made in increasing the total volume sold for a very extended period.

The Growth of the Oil Business

The oil business in the United States may be said to date from the year 1859. Previous to that time nothing worth mentioning had ever been done in the way of making the production and refining of petroleum a large and a serious business. In 1859 the states of Pennsylvania and New York were the only oil producers and their total output was only 2,000 barrels. By 1876 Ohio, West Virginia and California had been added to the list. In 1883 Kentucky and Tennessee entered the ranks. Since then, Illinois, Kansas, Texas, Missouri, Oklahoma, Wyoming and Louisiana have also become oil producing states.

During the first 50 years of the history of the oil industry the yearly output rose from 2,000 barrels to 179,572,497 barrels. The grand total for this period was 1,986,180,942 barrels worth $1,784,853,943 or more than half the value of all the gold and more than the commercial value of all the silver produced in the country from 1792 to 1908. The production in 1908 exceeded the value of the output of both metals.

The significance of these figures to the gas man lies in the fact that in so many ways oil comes into direct competition with gas. Oil is used to drive internal combustion engines, to do domestic and industrial heating and to furnish light. Wherever it is so used on the gas main of any gas company it is in direct competition with the gas business and is taking away from the gas company revenue that would help to increase the gas company dividends. Not only is this true but it is possible to derive by-products from gas works that will be very satisfactory substitutes for petroleum products where gas cannot be used directly.

It has become customary to look upon electricity as the greatest competitor to the gas business. The facts, however, would seem to indicate that oil is as great a competitor.

The oil business has been one which has developed all the markets possible. It has built up an immense by-product business and has always made the best of the new demands. Possibly there is no business in the country that has developed more rapidly during the past 60 years than has the oil business. This business stands on one side of the gas business. It has already invaded the field of light, heat and power to an alarming extent.

On the other side stands the electric business, a business that all gas men have been watching. The gas industry cannot afford to allow the electric industry to secure the business away from the oil industry that should go to the gas industry.

It, therefore, would pay gas men to study the methods which have been used in the oil business to develop the present markets, for it is evident that a great production of oil would be of little account if this oil could not be disposed of at a profitable price. Since the application of gas to light, heat and power are so nearly identical to those of oil such a study should offer very valuable suggestions to the gas man.

One of the first subjects which would of course prove of great value is that of domestic and industrial heating. Not only is there a tremendous consumption of oil for industrial heating in every industrial city, but the amount of oil that is burned annually in oil heaters to heat the rooms of houses along the gas mains which already have at least a service connection is far greater than most gas men believe it to be.

It seems to be possible to secure the house heating only through the popularizing of house lighting for gas. In no other way does there seem to be any possibility of persuading house owners to pipe their houses throughout for gas heating.

The industrial heating problem is strictly an engineering problem. Just as soon as gas companies employ engineers who are able to show the manufacturer the many advantages that gas has over oil there will be no difficulty in securing nearly all the present industrial heating for gas.

These are questions that are well worth serious consideration by the gas man. While he is watching the electric man he cannot afford to allow the oil man to take away business from the rear. He has already become fully aware of the oil man's activities in the industrial field but the tremendous sales of kerosene oil for lighting and heating in the homes already enjoying a gas supply has been overlooked to date to a very marked degree.

Labor Problem the Greatest Difficulty in English Gas Works in War Time

High Prices of Oil Cause Suspension of Large Number of Water Gas Sets—Vertical Retorts a Possession of Enhanced Value on Account of Class of Labor Available

By NORTON H. HUMPHRYS

After two and one half years' experience in carrying on the gas business under the numerous financial, commercial, and technical problems introduced into ordinary daily routine of Great Britain by the outbreak of war, some reference to the difficulties and troubles that have beset those responsible for the maintenance of a steady supply of gas during the period, may be interesting.

These have varied in kind and degree in almost every gas works, according to geographical position, magnitude of operations, and other local details, and I propose to keep strictly within the limits of personal experience, rather than attempt a general survey that would be based on second-hand and hear-say evidence.

At the outset I may mention that the damage to gasholders and other portions of the plant by the attacks of hostile aircraft is so exceptional as not to call for inclusion with considerations of a general character.

Photo by Underwood & Underwood

WOMEN IN GLASGOW PAINTING AND REPAIRING GAS STOVES

In No Sense a Criticism of Government Methods

This plain narrative of facts is in no sense intended as a criticism or as conveying any reflection on Government methods. Called upon to face a totally unexpected and unprecedented state of affairs, no doubt some mistakes have been made, but on the whole the authorities have risen to the occasion, and the only wonder is that there has been so little interference with the necessities and routine of ordinary daily life, and that after nearly three years of "frightfulness" on the part of a relentless and powerful foe, it is possible to walk any thoroughfare in city or village, mix freely with the inhabitants, and see very little evidence of the great war.

The first difficulty, following immediately on the declaration of hostilities, was the loss of the best class of retort house labor, and happy are those who are provided with vertical retorts or stoking machinery, as the clinkering of furnaces, drawing and charging of retorts by hand, etc., is not congenial to the very young or the very elderly man, to those who have been used to light labor, and all but impossible to females.

Many stokers were already reservists, and as such were immediately called up. The recruiting officers soon appreciated the fact that the arduous nature of retort house labor, involving habitual exposure to a wide range of temperatures, together with training in punctual habits, had provided first-class material, much too clearly to suit the manager's peace of mind, and the entrance to the gas works became a sort of happy hunting ground. The natural result of this was that the backbone of the staff speedily became a vanishing quantity.

When a man of this class was paid off on Saturday, there was no certainty as to his whereabouts on the following Monday. On one occasion a gang of nine men, due for the night work at 6 p. m., were paid off as usual at 1:30 p. m., and only four put in appearance at the starting hour; the remaining five were already 20 miles distant, en route for the nearest camp.

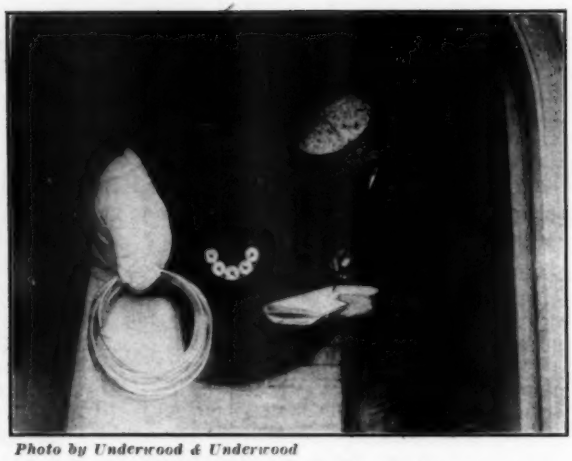


Photo by Underwood & Underwood

LEARNING TO READ THE GAUGE

Besides the enlistment or rejoining for active service, in many parts of the country the erection of military encampments or the establishment of munition works have called for a large amount of unskilled labor, which was secured by the simple expedient of offering exorbitant wages, and some districts were entirely depleted. This was a still greater strain on the gas works resources, as any class of labor was accepted, without inquiry as to age or capability.

Demand for Coal Increased by Shutting Down of Water Gas Plants

In many districts horses have been commandeered to such an extent that if the gas works is some distance from the nearest railway depot, and therefore dependent on road haulage, there has been great difficulty both as to inward and outward deliveries, in getting trucks promptly, which aggravate matters at a time when trucks are scarce.

The demand for coal has been enhanced by the fact that gas oil or similar liquid hydrocarbons have attained a prohibitive price, and only a limited supply is available at that. A large number of carburetted water gas sets are therefore lying idle, which means a proportionate addition to the output of coal gas.

In centers of military activity, the demand for gas has increased to the extent of 20, or even 30 per cent., notwithstanding licensing restrictions, daylight saving, and partial or entire abolition of public lighting. In places out of the run of military camps, routes, or munition works, a decreased consumption to the extent of 10 per cent. is the usual experience.

In either case, extension of business in the district is quite at a standstill, for more than one reason.

The outside staff has been cut down to a point barely equal to dealing with the normal complaints and change or been diverted from its proper sphere to the retort and purifier houses.

Not only advances in price, but also scarcity of the common metals, render it difficult to obtain metal goods of any description, and the leading makers of metals and appliances are to some extent under Government control.

Glassware of all descriptions is scarce, but as little demand for it exists, no trouble has arisen on that score.

There were fears of a famine in Thorium mantles, and a return to flat flames was freely discussed, but fortunately the matter did not materialize, and beyond some advance in price, there has been no difficulty, and I have not heard of any increase in the number of flat-flame burners in use, or decreased lighting consumption of gas on this account. Some undertakings, being called upon to meet substantial increases in output, in the absence of adequate excess of productive capacity, are heavily pressed by the restrictions on the issue of new capital in any form, or the difficulty of getting extensions or renewals executed promptly.

Restrictions as to Sale of Tar

Another matter that has also been eventually satisfactorily adjusted, is the glut of tar. At an early stage, the Government recognized the value of gas tar as a source of toluol and benzol, and with a view of conserving it for such purposes, placed restrictions on the use and sale of crude tar without first making sure that adequate means existed for the utilization of the large surplus thus thrown on the market.

The result was such a large accumulation of stocks that many were driven to great straits by overflowing store wells, and tar distillers were able to fix their own prices.

Concerns of sufficient magnitude to work up their own tar, are proceeding to do so. Amongst others, the Plymouth Gas Company has established its own tar works, and the right to purchase from its neighbors.

Sufficient plant has now been brought into operation to deal with the tar, and there is no difficulty in effecting clearance as required, but the price obtainable is a mere

Photo by Underwood & Underwood

WOMEN DOING METER REPAIR WORK

nominal sum out of all proportion to the intrinsic value.

The prices of oil of vitriol have more than doubled, and although that of ammonium sulphate has advanced, the net profit has declined, the increase not being sufficient to cover the enhanced rates for acid and labor. Several companies are building up a home connection, and selling direct to the users.

Coke has increased in value, in sympathy with the price of coal, and the assistance afforded by this residual has been one compensation, in the midst of a multitude of extra expenses.

The employment of women both at the gas works and on the district has been adopted, where possible, and considerable misapprehension has arisen in regard thereto.

There is no difficulty in any part of the country, in obtaining clerical helpers for meter reading, maintenance, office work, or collecting accounts, but it is only in the manufacturing districts of the north and midlands, that women capable of doing a day's work with the barrow or shovel can be met with. They have been used to heavy work in collieries, metal works, or brick yards, but in residential districts it is not possible to get women of sufficient physical stamina to go through a day's outdoor labor.

Some of the Government departments have overlooked this fact, and complain that in certain districts, full use has not been made of the feminine substitute.

Prosperous Public Utilities a Necessity to Growth of Other Industries

(*Continued from page* 347)

net earnings of the plant amounted to only 6 per cent. or less on its fair value.

Investors' Requirements

The facts thus presented indicate quite fully what was required in the way of property and net earnings in order that such standard securities as those mentioned might sell on given income bases. Since these facts represent actual experience in such matters it is also believed that the conditions thus disclosed with respect to the terms on which investors are ordinarily willing to furnish additional capital to public utilities are approximately correct. These requirements, or terms, of the investors can perhaps be summarized as follows:

Investors in order to furnish capital on bonds on a 5 to a 5½ per cent. interest basis appear to require that the principal of such bonds shall be protected by property and equities worth not far from twice as much as the par value of the bonds; that the interest charges on such bonds shall be protected by net earnings that amount to about twice as much as such interest charges; that the future prospects of the road or utility shall be such that as far as can be judged the financial condition of the plant is likely to improve rather than otherwise; that the above income basis shall not, as a rule, include the cost of discounts, commissions and issuing expenses. Such expenses must, therefore, be borne by the plant in addition to the interest charges.

Investors in order to furnish capital on stocks mostly appear to require that such stock shall not amount to much more than the amount by which the fair value of the property and equities exceed the par value of the bonds which come ahead of such stock; that the net earnings of the company on such stock shall amount to from one-half again to twice as much as the ordinary dividends of say 6 per cent. which are regularly paid in such cases; that in addition to such regular dividends, the stock also receives occasionally extra dividends; that existing stockholders be permitted to subscribe for new stock at lower prices than those which the stock in question brings in the market; that the future prospects of the plant, in so far as they can be foreseen, shall be such that the present relations between such stock on the one hand and the net earnings on the other are at least likely to be maintained, if not improved, in the future. In addition, there may also be expenses for discounts, commissions, etc., to be borne by the plants.

When both bonds and stock are outstanding the bonds are, of course, much safer than the stock. Among the reasons for this are that the bonds have the first claim upon the entire property and the entire net income of the property; that all claims of such bonds, both as to principal and interest, must be satisfied before the stockholders can claim anything; that the bonds carry with them the right of foreclosure in case the interest charges are not paid.

Terms and Conditions which Must Be Met

Bonds which come in the class just outlined are comparatively safe and carefree investments. In hard times and under forced liquidation stockholders must lose everything before bondholders lose anything. In return for such safety the bondholders are also satisfied with lower rates of returns. Where the bondholders' returns are not increased with increases in earnings, they are not, as a rule, reduced when the earnings decline. On bonds in this class both principal and interest are usually safe and protected. They, therefore, offer both stability and regularity of income.

When stocks are as well secured or protected by as big margins of safety and earnings as the bonds, they should also be about as safe. As a rule, however, stocks are much less well protected than the bonds. Stocks must also assume and carry greater responsibilities. Even when the stocks amount to no more than the difference between the face value of the bonds and the total value of the property and equities, there is not only no margin for safety of the principal but the property behind the stock may be required for the protection of the bonds. This is also true of the net earnings above bond interest. Yet when the net earnings for returns on such stock amount to from 50 to 100 per cent. more than the 6 per cent. that may be paid as dividends, such stocks are usually regarded as reasonably safe investment propositions for business men.

The lack of greater margins in the way of protection in the case of stock is thus, in a way, compensated for by the fact that the stock receives higher returns, not only directly in the form of regular dividends, but indirectly in the form of such occasional extra dividends, and such other rights as may be demanded or earned. Greater returns on stocks than on bonds are not only demanded because the stock is less well protected, but also because the stockholders have to assume the risks and responsibilities and much of the work of the management of the plant. These responsibilities, work and risks are often great. No one would assume them, at least in the long run, except with the understanding that they would be allowed extra compensation therefor in some form.

The stock also lacks the right of foreclosure, and,

unlike bonds which terminate at given intervals, represents a permanent investment in the property and business. There is no way, except upon complete liquidation, in which stock investments can be withdrawn from an enterprise. It is, of course, true that a stockholder may be able to sell his stock to some one else, but this is about the only way in which he can get his money back after it has once been invested.

These facts represent the terms and conditions which must ordinarily be met by those who expect to obtain capital on an investment basis. When the demands of the investors are less drastic than this it is usually because of special conditions which happen to obtain. Bonds and stocks which are not as well secured as those specified in the above requirements must be placed on terms which, as a rule, are much less favorable to the borrowers. Securities which do not come within these rules are usually regarded as speculative in character and are taken by speculators rather than investors. They are so taken on terms and conditions that are supposed to be favorable enough to the taker to offset the speculative features or extra risks involved. These terms are usually such as to make the cost of capital too high for most business purposes.

Risk as Applied to Public Utilities

The terms and conditions, including the margins for safety which are thus demanded by the investors, plus the cost of discounts, commissions and certain other expenses, represent the true cost of capital which, in the long run, must be borne by the public, or those who use the service, if the service is to be furnished. It is true that a part, at least, of this cost is sometimes shifted from the consumers to the investors through refusals to grant reasonable rates.

Under normal conditions in other respects, however, such shifting is neither fair, nor can it become permanent. The utilities must pay the ruling prices for all the labor, material and capital which they employ in the service. These prices are fixed, in the open market, by forces over which the utilities have little or no control. If these outlays are not covered by the rates which the utilities are permitted to charge for the services they render they cannot permanently remain in the business.

This applies as much to the surplus earnings as a margin of safety, which is demanded by the investors for their protection, as it does to any other item of cost. Such surplus net earnings, or margins, constitute a part of the compensation, over and above the regular dividends, which investors demand for the risks they assume. As long as risk remains a factor in the cost of production, it is also obvious that it must remain an element in the prices charged for the products.

Risk is a factor that varies as between industries, as well as between different plants in the same industry. In some cases it is much greater than in others, but there are no industrial undertakings in which it is not present. When its cost is not covered by surplus earnings in the form mentioned it is included in the higher interest, dividend and other charges which the investors exact, and which higher charges may be occasioned by the additional discounts or commissions which had to be granted when the capital was obtained because no such surplus earnings were shown.

When the road or plant regularly earns about 8 per cent. on its fair value the cost of the capital is made up of the interest and dividends actually paid and of the surplus for safety. When the plant earns only say 5 or 6 per cent. or less on its fair value the cost of the capital has to be covered by the amounts paid as interest and dividends, or the amounts earned for these purposes, plus the cost of the discounts and other outlays which the road or utility must assume, because when earning only 5 or 6 per cent. or less, its credit is so much poorer that it cannot obtain capital on as favorable terms as when earning 7 or 8 per cent.

The money cost to the public of the capital obtained is, therefore, likely to be fully as great under the lower as under the higher earnings.

Under normal conditions there appears to be no way in which the public will derive any permanent benefit from refusing to allow rates for the service obtained that are high enough to yield the small surplus that is necessary to maintain the credit of the utilities. Even if there were instances where the direct money cost would be a little less when no surplus is provided for in the charges for the service, the slight savings from this source would certainly, in the long run, be fully offset by poorer facilities and services and by less adequate provisions for safety in other respects.

The cost of the capital is as much a part of the cost of the service as is the case for the cost of material and labor that enter into such service. This is as true when the cost of the capital is, in part, represented by a necessary surplus as when in place of such surplus it is represented by discounts and other costs which are imposed because of the lack of such surplus earnings.

Entire Cost of Service Must Be Borne By Public

In the long run and under normal conditions, the entire cost of the service must be borne by the public through the rates paid for such service. If it is not so borne it is certain that in the end no one will remain in the business.

That in the long run the public is not likely to be a gainer by failing to allow rates for the service that will yield such surplus or margin of safety as that demanded by the investors, may also be illustrated in the following manner:

A utility requiring say $100,000 of additional capital, but earning only 6 per cent. or less on the fair value of the plant and its business, could probably not on the average sell its 6 per cent. securities at much over 80. In order to obtain the $100,000 it would, therefore, have to issue $125,000 of securities. On this amount interest at 6 per cent. would foot up to $7,500 annually, while the amortization of the discounts in 25 years would require an additional $1,000 each year. This would make the total annual cost of the capital about $8,500.

A utility earning say not less than 7.5 per cent. on the fair value of its plant and business, and capitalized accordingly, could probably sell its 5.5 per cent. bonds and 6.5 per cent. stock at par. If, of the $100,000 capital needed, one-half was raised on bonds and the other half on stocks, the annual interest and dividend charges would amount to about $6,000. This would leave about $1,500 for the margin of safety required by the investors, while the total annual cost of the capital would be $7,500, or about $1,000 less than under the conditions outlined in the preceding paragraph.

The price of capital varies from one period to another. The investigations upon these points indicate that bonds, which are protected by such surplus property and net earnings as those demanded by the investor were selling on about a 4 per cent. income basis

from about 1900 to about 1907. In the latter year, however, the yield demanded increased to about 4½ per cent., and remained at this figure up to about 1909, when it again increased to about 5 per cent. In 1913 and 1914 it rose to over 5 per cent. On investment stocks of the kind described above the yield demanded by the public, in addition to a surplus for safety, was from 1 per cent. to about 2½ per cent. greater than the yield thus demanded on the bonds.

Cost of Capital Increases From 20 to 40 Per Cent. In 20-Year Period

This shows that during the fifteen-year period which preceded the year 1915 the cost of capital increased from about 20 to about 40 per cent., depending upon the conditions. These increases in the cost of capital were due to several causes. One of these is the general increase in prices due very largely to the increase that has taken place in the supply of gold or money. When the supply of money increases more rapidly than the demand for it, the result is that the value of money falls and that the prices of those things which are purchased with money tend to rise. In other words, these changes in the demand and supply of money cause the gold or money price of commodities to rise. Advancing commodity prices thus reduce the purchasing power of the income from money and forces those who depend on such money income to demand higher rates of interest.

In 1914 the prices of the commodities and labor were about 48 per cent. higher than in 1897. To-day these increases over 1897 amount to more than twice as much. That these great reductions in the purchasing power of money should also have increased the cost of capital, is rather obvious.

Such increase in the cost of capital is felt more strongly in the junior and weaker securities than in the better underlying first mortgage bonds. The prices on first mortgage bonds of the better kinds, both in times of stress and in times of prosperity, usually change so slowly that the yields on their market price do not furnish a very accurate index to the course of the cost of capital. This is easily explained.

A large proportion of the bond buyers are so persistently adhering to the purchase of these kinds of securities that they keep on buying such bonds under almost all kinds of conditions. This in turn, by increasing the demand for them, tends to stiffen the prices on such bonds. Such institutions as savings banks, insurance companies, estates held in trust, etc., which are restricted by law to the purchase of the better bonds for investment, also, through their purchases, tend to keep the prices of such bonds up to a comparatively high level. The regularity of the income and of the prices of such bonds, also attract temporary investors, who, while awaiting the time when their funds will be needed for other purposes, like to place them in securities which have a ready sale and stability of price.

Tendency of Better Bonds to Decline in Selling Price

But while all this is true, there has been a marked tendency, during the past ten years or more, on the part of the better bonds to fall in price. The main reason for this is undoubtedly found in the effect of rising prices of commodities on the purchasing power of the income from the bonds.

When, as has been the case for almost twenty years previously to 1915, the prices on what money buys have risen at the rate of more than 2½ per cent. per year. the purchaser of a $100 bond at par needs $102.50 at the end of the year in order to have the same purchasing power as at the beginning of the year. If his $100 bond bears interest at say 4.5 per cent. he will have $104.50 at the end of the year. This is $4.50 more than he invested, but it is only $2 more than the purchasing power of the money he invested. His net interest, therefore, amounts to only 2 per cent. instead of 4.5 per cent. as he expected. It is conditions like these which cause investors to demand higher and higher rates on capital they furnish.

Under strict regulation, most speculative opportunities are eliminated. Those who hold the stocks, for instance, may not be permitted any benefits from increasing values due to social growth, nor any considerable proportion of the increased profits derived from growths in the business and from general developments. Speculative opportunities of this kind are much cherished. They have in the past regularly caused investments to be made on much lower bases of returns than those at which capital could otherwise have been had. With the growing tendency under regulation to take away such speculative opportunities, there has also arisen a tendency on the part of the investors to demand higher rates of income on the securities upon which they furnish capital. This is especially true of such securities as stocks.

The effect, upon the rates of return or on the cost of the capital, of adverse political conditions, actual or proposed legislation, and the manner in which such legislation is likely to be administered, may also be illustrated.

Effect of Stringent Regulation on Investor

From about 1896 to about 1906 the railways were comparatively free from restrictive legislation, and had also control of their rates. As in addition to this, the business of the roads was growing quite rapidly, and their prospects were regarded as good. This, in turn, was reflected in good credit and in the low cost at which they could obtain additional capital.

Some time before the end of this period a vigorous political agitation against the roads had arisen, which ultimately resulted in much stringent legislation. The Federal and State commissions were given full power over rates, and the indications were that these powers would be vigorously exercised. This caused investors to think that the roads had lost all power over rates and earnings; that it would be the tendency of the commissions, in rate decisions, to be guided by the earnings of the better situated roads and to hold the earnings of even these roads down to the lowest levels that would escape the rules of unreasonableness; that from that time on the investors in railway securities would have to accept lower returns than those which could be obtained in other lines of business; and that they would also be subjected to other restrictions.

These, together with other considerations of a similar character, caused the more cautious or careful investors to withhold capital from the railways and seek other fields in which to place their funds; to begin to gradually dispose of the less well protected securities which they hold; to demand higher rates of return on such investments as they made in new railway securities; to prefer short time notes to bonds because of the impression that these notes would mature before the conditions of the roads had become too serious, and before the effect of the constantly increasing prices

on labor and commodities had become too seriously felt in the net earnings of the roads.

In fact, the investors began to assume these positions toward railway securities while the net earnings of the roads were as high as ever because they foresaw or thought they could tell that the future prospects of the roads were anything but rosy. Some investors are easily affected by conditions such as those described and are apt to govern their course accordingly. Other investors, again, are close students of economic and financial conditions, and in this way are able to look ahead and to estimate coming conditions with a considerable degree of accuracy. They are also governed by these estimates of coming conditions in placing their funds.

Large Bond Indebtedness in Hard Times

These facts are not given as an argument against regulation. For regulation in some form is necessary and has come to stay. They are simply cited as examples of how easily the credit situation may be disturbed in such a way as to injure public interest, and how necessary it, therefore, is on the part of the commission in administering these laws, to be guided by sound economic and business principles.

In comparing the facts and conditions which thus constitute the requirements of the investors, or the conditions upon which they will furnish capital, with the value of the plants and the business, with the capitalization and the earnings and operating expenses of most railways in this country, and with similar facts for other utilities, it will be found that many roads and other utilities are not in such a situation with respect to their credit or property and earnings that they are likely to be able to secure all the additional capital they need on reasonable terms and conditions.

Even where the value of the plants and of the business equals the outstanding securities the earnings on the stock are frequently far from high enough to place such stock on an investment basis, or to induce investors to furnish capital thereon. In fact, the situation, with respect to the earnings is often distinctly unfavorable, that is, the earnings are often too low to be reasonable and much below the level at which new capital can be had, particularly on stocks. This forces utilities to obtain additional capital on bonds alone and this, in turn, tends to cause the proportion of the bonds of the total capitalization to become too high for safety.

In hard times an unduly large bonded indebtedness is likely to mean receiverships with all the losses and disturbances that are entailed thereby. It is seldom safe to let that part of the capitalization which is represented by bonds greatly exceed 65 to 75 per cent. of the total amount of both the stocks and the bonds. In this respect many other classes of utilities seem to be better situated than the railways. One reason for this is that the railways seem to be more greatly affected by competitive conditions and by the industrial situation than is the case for most other utilities.

From an investment point of view, the securities of the railways have, as a rule, ranked the highest, while the securities of gas and electric companies have come next, and have been followed by telephone and other classes of securities. Of late, however, these differences in favor of railway securities have tended to diminish; in fact, there are many instances where the situation is now reversed. The reason for this is that the railways seem to have been more greatly affected by the rising prices of labor and commodities than other utilities, and that the railways always find it difficult to adjust their rates in line with these tendencies in the prices of what they use. (Of course, many other utilities are also in the same position in these respects as the railways.) The underlying first mortgage bonds of most of our larger railway systems, however, particularly those which are legal investments for savings banks and insurance companies, undoubtedly still hold the first place among public utility securities in the investment world.

Publicity as Related to Obtaining Money Cheaply

The terms and conditions upon which investors are thus willing to furnish capital as developed from the prices which the securities have been selling in the market, and from the value of the property, and the amount of the net earnings by which these securities had to be backed up in order to sell at such prices, apply for the most part, to the larger and better known railways and utilities. The securities of the smaller roads and utilities, under similar conditions as to the property and earnings by which they are protected, sold at lower prices than those quoted or at prices on which the yield obtained was considerably higher than the yields given herein. In other words, the smaller utilities were not only less well known but were also less attractive from an investment point of view.

The full meaning of the facts which have thus been presented is best brought out when they are applied to specific cases. They indicate very closely that under ordinary conditions the roads and utilities, in order to meet the demands upon which the investor is willing to supply additional capital, must have net earnings for interest on the bonds, dividends on the stock and a a surplus for safety, which altogether amounts to not less than about 8 per cent. on the fair value of the plant, its equities and business. With such net earnings as these, and when the bonds do not cover more than from 50 to 75 per cent. of the total value, the bonds would probably sell in the market on about a 5 to 5½ per cent. income basis, while the stock would likely sell at prices on which the yield would amount to from 1 to 1½ per cent. more than this. With a much lower net income than about 8 per cent. on the fair value of the plant and its business, the plant could not, in the light of the facts here presented, very well, be placed in the investment class.

The Earliest Beneficiaries of Gas Lighting

Many ages ago—before man appeared on the earth—Nature evolved illuminating gas for purposes of her own. If we assume that the Diplodocus or Ichyosaurus—prehistoric gentlemen about the size of the Woolworth building—were nocturnal in their habits, it is pleasant to know that their nightly feeding or carousing in the vast swamps wherein they lived was fitfully illumined by the flashing of occasional jets of natural gas.

As the monstrous dinosaurs and saurians of that period possessed brains about the size of a peanut, it is hardly fair to assume that they reflected philosophically, or saw in the elusive glare of the will o' the wisp a prophecy of modern civilization in which illuminating gas and perfect methods of cooking by gas, plays so large a part.—*Gas Logic.*

News of the Gas Industry

Pennsylvania Gas Association Secures Timely Paper

The relation of the gas industry to the military needs of the nation will be brought out by James H. Burns, captain in the United States Army, in a paper to be presented at the first day's session at the annual convention of the Pennsylvania Gas Association, to be held at Reading, April 12-13. The credit for securing this timely and valuable paper must be given to Robert ffrench Pierce, chairman of the Papers Committee.

On account of the subjects dealt with and the excellence of the subjects that will be discussed, a larger proportion of the big figures in the gas industry than is usually the case at State association conventions is indicated by assurances already received.

Increases in Gas Uses at Rutland, Vt.

For 1916, the Rutland Railway, Light & Power Company's gas sales were 5.14 per cent. over those of 1915, and the amount of gas sold for industrial uses increased 58.8 per cent., amounting to 3,680,000 cu. ft. One hundred and eighteen new services were installed last year, and there was a gain of 112 ranges, 164 water heaters and 160 meters.

Franchise for Vincennes, Ind., Drawn Up

At a meeting of the Board of Public Works scheduled within a few days, in all probability a franchise will be granted by that body to the Central States Gas Company, to furnish gas to the citizens of Vincennes, Ind.

The franchise has been drawn up but as yet there are several minor details to be decided upon.

The franchise calls for a life of 25 years, and fixes the rates governing the furnishing of artificial or a combination of artificial and natural gas.

The franchise calls for a price of 65 cents to be charged for mixed gas for the first 5,000 feet consumed during any month, and 50 cents for amounts used above that quantity. A 10 cent penalty for non-payment of the bill by a specified date is permissible.

Artificial gas rates are as follows:
First 2,000 ft. per month.....95c
Third 1,000 ft. per month.....90c
Fourth 1,000 ft. per month.....85c
Fifth 1,000 ft. per month.....70c

All over 5,000 per month 50 cents net, with a 10 cent penalty for non-payment of bills. Minimum charge of 50 cents may be collected.

The adjustment of rates, and the granting of the franchise will end a several months' effort to come to an agreement. The city council will have to pass an ordinance ratifying this agreement between the gas company and the board of works.

Council Agrees to Buy Plant

At a meeting of the City Council of Mesa, Ariz., held recently, it was agreed that the Council will purchase the Southside Gas & Electric Company on a basis of $113,000. This covers the auxiliary plant northwest of town, plant, poles, wiring, etc., in town, and on the rural lines. Harry Chandler retains the business of Tempe & Chandler for gas and electricity, which is to be furnished to him at cost for five years. As soon as the proper steps have been taken the proposition will be placed before the voters of the town.

Petition for Bonds from Springfield Company

Petition was received recently by the gas and electric light commission, from the United Electric Light Company of Springfield, Mass., for authority to issue 5,000 shares of capital stock at the rate of $100 a share par value. The capital stock of the corporation is fixed at $2,000,000.

Members of the commission said that the last issue of United Electric Light stock was at $185 a share and that on such a rating it would mean the addition of about $1,000,000 capital stock for the corporation. Hearing on the petition, which the commissioners say should interest a large number of the citizens of Springfield, has been set for Thursday, April 12, at 2 o'clock. The capital is asked for "payment of liabilities and additions and extensions of the plant of the corporation."

Robert W. Day, president of the United Electric Light Company, has said that the company has been engaged for the last year in rebuilding its plant, making large additions and increasing its capacity by expensive machinery and the increase in capital stock is to partly pay for these, and for whatever indebtedness and other additions the company may decide to take care of.

Many Companies Guard Plants

The Fall River Gas Works Company and the Fall River Electric Light Company, both have special watchmen on duty to guard against the possibility of harm being done to their respective plants by any one who might be influenced by existing unsettled conditions, to do damage.

The gas works company has on duty at its generating plants four of its own men, sworn in as constables, and authorized to carry, and if necessary, use arms. Only those known to have legitimate business are allowed to enter upon the company's properties. Owing to the trade in coke and other needs for carting, the Charles Street plant cannot be closed against all comers except company employees.

Following an inspection of the pipe line between the High Hill, Mass. reservoir and the pumping station near Lakeside recently, Mayor Ashley gave orders for the placing of electric lights all along the line to facilitate the guarding of the property. The Mayor was accompanied on his trip by D. W. Beaman and Everett W. Cole of the New Bedford Gas & Edison Light Company.

At the request of the Worcester Gas Light Company, Mayor P. G. Holmes last night appointed 27 of its employees special policemen. The appointments were confirmed by the Board of Aldermen.

In addition to the special guard under former Sergeant Williams, 50 employees of the New Haven (Conn.) Gas Company have combined in voluntary association to protect the plant of the company.

Mayor McPherson of Beverly, Mass., at a special session of the Aldermen recently named 50 citizens as special policemen to guard public utilities in case of emergency. The men were named for duty at the

United Shoe Machinery plant, the Beverly Gas & Electric Company plant, the Sprague, Breed & Brown Coal Company and the Gulf Refining Company, the city water works, sewerage pumping station, reservoir and Wenham Lake, the source of water supply. The various private concerns are equipping their own men while the city will equip its men for the public departments' work.

Another of the big local corporations, the Lawrence (Mass.) Gas Company, has taken steps to guard against any destruction of its property should an emergency arise or any trouble arise as the result of the present threatening national situation.

It was learned that the Lawrence Gas Company has erected a number of powerful lights about its gas plant on Marston street and along the north bank of the Merrimack River and surrounding its electric light plant. Extra men have been put on to patrol the two plants to guard against damage which would materially affect the city by throwing it into darkness.

Other big corporations are expected to take similar action of some kind and many of them have already done so.

Model of Gas Works for Exhibition

The Washtenaw County Gas Company has promised to build a model of its plant for exhibition at the municipal exhibit to be given shortly in the council chambers of the City Hall at Ann Arbor, Mich. It will show how the gas company carries on its work.

The Ann Arbor Civic Association will have placards showing what the association has accomplished for the city. The department of public works has set up a model showing how the sewers of the city are laid, how they are cleaned, how the manholes are placed in position, and in what places the large 24-inch pipes are used.

Invitations will be sent to all the school children the first part of the week to attend the exhibit with their parents.

It is the purpose of the officials in charge of the municipal exhibit to permit the people of Ann Arbor to see exactly, by means of models, drawings, charts, and physical exhibits, how the city government is carried on. The exhibit will be free and will be open morning and afternoon for a week.

Advance in Price of Water Heaters

The Dayton Manufacturing Company of Dayton, Ohio, have decided that, due to the increased cost of raw material, an advance must be made in the price of the "Ohio-M" instantaneous bath water heaters. The former price list has been withdrawn and a new schedule effective March 26 has taken its place. This journal is indebted to R. J. Hutchins, manager of the heater department of the Dayton company for the foregoing information.

Plans to Prevent Future Natural Shortage

An increase of 27,000,000 cu. ft. of gas daily in time of need is to be provided for Cincinnati, O., under plans outlined by President W. W. Freeman of the Union Gas & Electric Company, and made public by Mayor Puchta recently in an address before the Walnut Hills Business Men's club. Twelve million cubic feet a day additional is to be secured through a new contract with the Ohio Fuel Supply Company, under which the company will be required to deliver 20,000,000 cu. ft. a day, when needed, at the Norwood station of the company. Fifteen million cubic feet of producers gas will be furnished through the equipment of the West End gas works for the manufacture of this gas. The plant will be utilized only in times of stress. The producers gas will readily mix with the natural gas, it is said. With the additional supply from the Ohio Fuel Supply company, President Freeman said in his letter, "we will be able to furnish a satisfactory volume and pressure of gas throughout Madisonville, Hyde Park, Oakley, Avondale, Clifton, Walnut Hills and Mt. Auburn, where the service has been inadequate previously in extreme cold weather." Another important improvement announced by Mr. Freeman is the laying of 46,500 ft. of new high-pressure feeder mains, as substitute for existing feeders which have proved inadequate in cold weather, especially in the suburbs of Cheviot, Westwood, Price Hill, Mt. Airy, College Hill and Mt. Healthy. The mayor, in his address, defended his action in approving the 35-cent gas rate ordinance, and his settlement of the 8½-cent electric rate. He urged support of the new street railway franchise and loop lease ordinance.

New York Section Illuminating Engineering Society

In a note on the activities of the New York Section of the Illuminating Engineering Society which was published in the news section of the March 17 issue, reference was made to W. Greeley Hoyt as president of the Municipal Light Company. Although this reference was accurate it proved confusing to some readers, as Mr. Hoyt is better known in the field as president of the Standard Gas Light Company, which office he also holds.

Sales Increased at Rocky Mount, N. C.

According to a recent statement given to this journal by James Bowdoin Cocke, engineer and superintendent of the Rocky Mount (N. C.) Public Works, the sales from the beginning of the fiscal year, May 1, 1916, to January, 1917, increased 54 per cent., and for the first ten days of February, 1917, they increased 83.5 per cent. over the same period one year ago.

Indiana Company Petitions for Franchise

The Warsaw (Ind.) Gas Company has filed a petition with the county commissioners for a franchise to operate their mains in Wayne township. The franchise is asked for a period of fifty years. The petition also asks for the right to lay mains east from the city limits at the end of South street and also from the east end of Center street. These mains are sought with a purpose of reaching the customers at Winona Lake. The gas company now furnishes light at Winona but are planning to lay new mains in the near future.

Hale Gas Company Sells Its Franchise

The Hale Gas Company of Neodesha and Kansas City, Kan., has sold its franchise and city gas lines at Altoona to the Union Public Service Company of Kansas City, which supplies twenty cities in Kansas and Oklahoma with gas. The Cherryvale Gas, Light & Power Company another one of S. H. Hale's holdings, has been sold to the same company. Mr. Hale intends to devote his time to the Eureka Oil Company, recently organized at Kansas City.

GOOD ARRANGEMENT IN SMALL SPACE AT BOARD OF TRADE EXHIBIT

Unique Board of Trade Exhibit

One of the most complete exhibits of the many gas appliances handled by the Citizens' Gas Light Company of Quincy, Mass., is shown in the above illustration. This display was given at the Board of Trade exhibition held in Quincy during the week of March 12. Many good ideas may be obtained for display arrangements by careful inspection.

Considerable interest and comment were aroused, and a great deal of goodwill established for the company by this Board of Trade exhibit, according to W. B. Nichols, general manager of the company, to whom this journal is indebted for the above illustration.

N. C. G. A. Pledges Support to Government

The quick action and loyalty of the gas fraternity is shown in a letter which has recently been sent to the President of the United States by the National Commercial Gas Association. The determination and willingness to meet the emergency is brought out clearly in the following letter:

The President:

The Board of Directors of the National Commercial Gas Association, at a meeting held in Chicago, Ill., on Mar. 23, authorized a special committee, composed of the undersigned, to convey to the President of the United States its pledge of support in the present emergency and to tender herewith the facilities of its organization to co-operate with the proper authorities in prompt preparation for the national defense.

Very respectfully,
(Signed) W. Griffin Gribbel,
Oscar H. Fogg,
Percy S. Young.

The President of the United States,
Washington, D. C.

Corporation's Part in National Defense

Considerable commendation is due the Consolidated Gas, Electric Light & Power Company of Baltimore for their quick action in this time of national crisis. Although a considerable number of their employees had just returned from the border and a banquet welcoming them home had been given, the action shown in the two notices given below is certainly worthy of comment.

On Mar. 27 a notice was sent to all department heads, the wording of which follows:

ALL DEPARTMENT HEADS:

IN THE EVENT OF THE REMOBILIZATION OF THE NATIONAL GUARD, THIS COMPANY WILL PROVIDE FOR THE NATIONAL GUARDSMEN IN THE COMPANY'S SERVICE AS FOLLOWS:

ALL COMPANY EMPLOYEES WHO ARE MEMBERS OF THE NATIONAL GUARD AT THIS DATE WILL RECEIVE LEAVE OF ABSENCE AS THEY MAY BE CALLED FOR MILITARY DUTY, WITHOUT LOSING THEIR POSITIONS, PROSPECTS, OR BENEFITS NOW PROVIDED BY THE COMPANY, AND WILL RECEIVE FULL PAY WHILE ABSENT FROM THE COMPANY'S SERVICE ON MILITARY DUTY, LESS THE AMOUNT OF PAY RECEIVED FROM THE STATE OR FEDERAL GOVERNMENT.

AT PRESENT THIS WILL NOT APPLY TO NEW ENLISTMENTS ON AND AFTER THIS DATE. SHOULD THERE BE A GENERAL CALL BY THE NATIONAL GOVERNMENT FOR VOLUNTEERS THE COMPANY WILL TAKE SUITABLE ACTION IN CONNECTION THEREWITH.

YOU ARE REQUESTED TO IMMEDIATELY OBTAIN THE NAMES AND RANK OF THE NATIONAL GUARDSMEN IN YOUR DEPARTMENT AND FORWARD THEM TO THE TREASURER'S OFFICE.

EACH NATIONAL GUARDSMAN SHOULD DESIGNATE, IN WRITING, THE PERSON TO WHOM HIS SALARY SHOULD BE PAID DURING HIS ABSENCE.

HERBERT A. WAGNER, PRESIDENT.

On the following day this second notice was sent to all department heads, which agrees that all volunteers called into United States military service will receive full wages during active Government service:

TO ALL DEPARTMENT HEADS:

SUPPLEMENTING THE NOTICE SENT YOU YESTERDAY IN CONNECTION WITH THE COMPANY'S PROVISION FOR NATIONAL GUARDSMEN, YOU ARE HEREBY NOTIFIED THAT AT AN EXECUTIVE COMMITTEE MEETING THIS MORNING, THE SAME PROVISION WAS EXTENDED TO ALL ENLISTMENTS IN THE SERVICE OF THE GOVERNMENT AS FOLLOWS:

"EVERY MAN NOW IN THE EMPLOY OF THE COMPANY, WHO IS CALLED INTO THE SERVICE OF THE ARMY OR NAVY OF THE UNITED STATES, AND EVERY MAN NOW IN THE EMPLOY OF THE COMPANY, WHO HEREAFTER SHOULD VOLUNTEER OR IS CALLED INTO THE SERVICE OF THE ARMY OR NAVY OF THE UNITED STATES, WILL BE PAID HIS FULL WAGES DURING HIS ACTIVE SERVICE WITH THE GOVERNMENT, LESS HIS GOVERNMENT PAY, AND WILL BE GIVEN EMPLOYMENT BY THE COMPANY UPON HIS RETURN."

HERBERT A. WAGNER, PRESIDENT.

Improvements at Mt. Clemens, Mich.

The Mt. Clemens (Mich.) Gas Light Company is having the Gas Machinery Company install for them three benches of one-half depth 6s of silica retorts and settings. This will greatly increase the output of the company, and is in line with their endeavor to give better service.

This journal is indebted to Joseph C. Markley, engineer of the Mt. Clemens company for the foregoing information.

Canadian Gas Association to Meet with National Commercial Gas Association at Next Convention

It has been recently decided that the Canadian Gas Association will meet with the National Commercial Gas Association in convention this year at Detroit, Nov. 12-17. The increasing activities among Canadian gas affairs promises to make the Canadian representation in November one of note.

The Canadian Gas Association is now affiliated with the American Gas Institute. Howard E. Mann, engineer gas division, Montreal Light, Heat & Power Company will therefore represent the Canadian Association on the American Gas Institute directorate, according to information recently received from George W. Allen, secretary and treasurer.

Gas Company Aids Soldiers

The Laclede Gas Light Company of St. Louis, Mo., has loaned the First Regiment, National Guard of Missouri, fifteen gas ranges to be installed at the armory, where the troopers have been gathered. The company sent out special workmen to install a main so that everything was ready by evening for the first dinner.

Ashland Company to Supply Gas to Steel Plant

It is understood that the Ashland Solvay Gas Company of Ashland, Ky., which was granted the right recently by Council to lay gas mains through the streets of Ashland, will lay a line to the open hearth steel plant and furnish this institution with gas from the Solvay ovens. Several other industries may also be supplied with gas from the same source.

West Virginia Companies to Increase Rates

The Public Service Commission, West Virginia, on the occasion of the regular monthly hearing accorded petitioners, entered orders permitting the charging of increased rates to consumers supplied with gas by the following corporations:

Jarvisville Oil & Gas Company of Jarvisville; Home Petroleum & Natural Gas Company of Shinnston; Shinnston Natural Gas Company of Shinnston; Comet Oil & Gas Company of Pruntytown.

Alleged exorbitant gas bills rendered by the company supplying gas in the town of Ceredo recently led to complaints to the commission. Inspectors were sent to learn the truth about conditions. They returned to-day and reported that there had been a waste of gas through a broken main and that the consumers had each contributed toward paying for the loss.

GAS
Factory Equipment is the "Yardstick" of Production
It is the measure of both quality and quantity.
Every piece of equipment which falls short of highest efficiency is a drag on the value and volume of output.
For any product requiring Japanning, Lacquering or a similar "Baking" process
An Indirect Gas-Fired Oven
sets a standard of production which demonstrates the inefficiency of all other methods of Drying.
Its "Radiator" construction heats quickly and holds an even temperature. It maintains a constant circulation of fresh air that ensures uniform quality and quicker output. It eliminates the handling of coal or coke and prevents damage to work from products of combustion. Its complete insulation gives minimum Gas consumption and meets all safety requirements of the Board of Fire Underwriters.
Indirect Gas-Fired Ovens are built in any size. Cut shows "Radiator" type of Japanning Oven. Inquiry at the INDUSTRIAL APPLIANCE DEPARTMENT, 130 East 15th St., will give all desired details
Consolidated Gas Company of New York
GEO. B. CORTELYOU, President
"The Right Way is the Gas Way"

TYPE OF ADVERTISEMENTS BEING CARRIED IN NEW YORK PAPERS

More Industrial Fuel Advertising

The above illustration is a reproduction of a newspaper advertisement inserted in the New York papers by the New York Consolidated Gas Company.

The many uses for industrial gas can be best explained to the general public through this medium and the goodwill thus created becomes an important item when the time comes for the manufacturer to choose his future fuel.

Wisconsin Company to Serve New Territory

The Wisconsin Gas & Electric Company, which operates the Racine gas plant, will extend its service to St. Martins, it is reported. The company supplies gas to Cudahy and South Milwaukee.

Walter A. Allen Dead

Walter A. Allen died at 5.45 p.m. Mar. 28, 1917, at his late residence, 323 Decatur Street, Brooklyn, in his 71st year.

He was born in Staten Island, N. Y., August, 1846.

When seventeen years old he shipped as apprentice on the Clipper ship Grand Republic around Cape Horn to San Francisco, where he enlisted in the California Cavalry and served three years through the West and South in the Indian country. At one time he served under old Kit Carson and was wounded in an engagement with Indians on the plains.

He first entered the gas business in the early eighties with the Fulton Municipal Company, South Brooklyn. Later he was connected with the Albany Gas Company with E. C. Benedict and Anthony Brady. Afterwards he succeeded his brother, Henry, as superintendent of the New York Mutual Gas Works, New York, about 1894. He was also a member of the Society of Gas Lighting.

He retired from active business life about six years ago.

Societies and Associations

THE ILLUMINATING ENGINEERING SOCIETY, New England Section, will hold its monthly meeting at 8 o'clock, Wednesday, April 11, at the Massachusetts Institute of Technology, Cambridge, Mass. Mr. Luckiesh will speak on the subject of "Linking Science and Art with Practice in Lighting." Mr. Luckiesh is the Physicist of the Nela Research Laboratory of the National Lamp Works of the General Electric Company, and from his several interesting papers in the past an enjoyable and educational evening can surely be expected.

THE PACIFIC COAST GAS ASSOCIATION held their first "Get-Together" dinner on Thursday, April 5, at the Palace Hotel, San Francisco, at which time much of the information concerning arrangements of their twenty-fifth convention was discussed.

THE MICHIGAN GAS ASSOCIATION held a meeting of the Fellowship and Executive Committees at

(*Continued on page* 16 *of Advt. Sec.*)